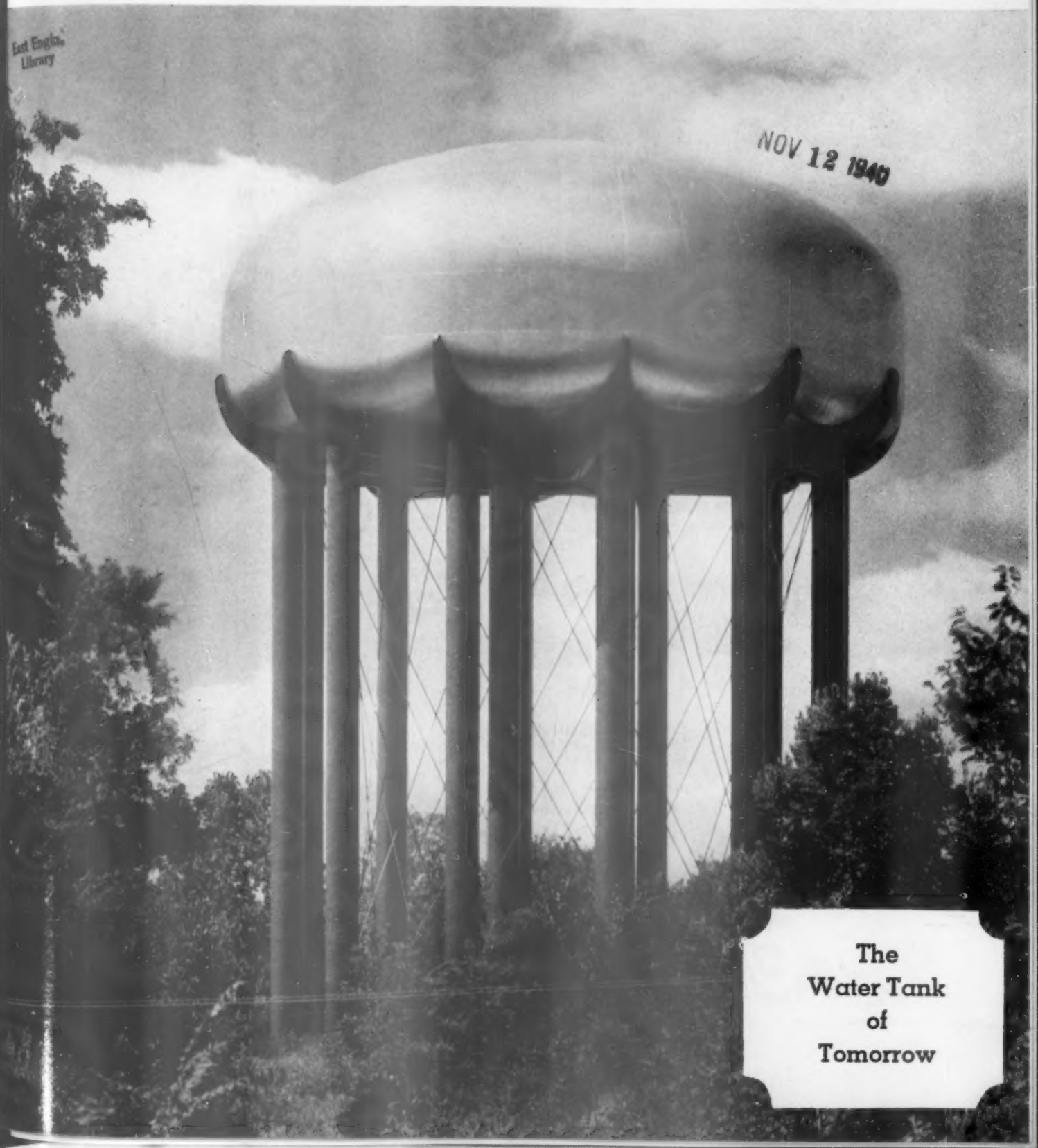
The Welding Engineer

PIONEER BUSINESS AND TECHNICAL JOURNAL OF THE WELDING INDUSTRY

Volume XXV **November, 1940** Number 11

East Engin. Library

NOV 12 1940



The Water Tank of Tomorrow

Model F-3. Fully insulated. 300 Amps. 1/8" to 1/4" rods. Weight 22 oz. Replaceable jaws of Mallory 3 Metal.

NEW . . a "Streamline" Holder for "hard-to-get-at" places . .

This fully insulated Jackson holder is designed for perfect balance, quick maneuverability and long life. The concealed spring enclosed in the vulcanized fibre handle exerts 80 lbs. pressure on the electrode, holding it in a vise-like grip at ANY angle. Blade members and replaceable jaws are made of Mallory 3 Metal, assuring exceptional conductivity. Mechanical cable connection provides secure, perfect contact. It's a safe, well ventilated, cool working job. You'll like this holder.

See your nearest dealer to-day, or write us.

If you prefer a BARE TYPE holder of the same capacity, we recommend our Model B-2 — above. Handle, thumb grip and spring are fully insulated. Well ventilated, it works cool. Weight 19 oz.

Write today for the Jackson Holder folder illustrating and describing nine different models.

JACKSON ELECTRODE HOLDER CO.

15122 Mack Avenue **Detroit, Michigan**

Canadian Distributors: Hollup Corporation, Limited, Toronto - Paragon Supplies, Limited, Vancouver

NOVEMBER, 1940

The Welding Engineer

MEMBER

Associated Business Papers
Audit Bureau of Circulations
American Welding Society
International Acetylene Association

G. H. MACKENZIE
President and Treasurer

T. B. JEFFERSON
Editor

M. S. HENDRICKS
Promotion Manager

» «

Eastern Representative:
T. F. DEPEW, 1834 Broadway, New York, N.Y.
Tel. Columbus 5-7843.

Pacific Coast Representative:
W. R. McINTYRE, 400 East Third St.
Los Angeles, Calif.

» «

Published on the 1st of each month by The Welding Engineer Publishing Company, 506 South Wabash Ave., Chicago, Ill.

Telephone Webster 7134.

Advertising copy must be received not later than the 20th of the preceding month

COVER

A 1,500,000-gallon elevated water tank of radial-cone bottom design built for Indianapolis Water Co. of Indianapolis, Ind. (Photo Chicago Bridge & Iron Co.)

IN THIS ISSUE

ARTICLES

Oxy Acetylene Welding of Light Aircraft 17
Highlights of the A. W. S. Annual Meeting 22
A Digest of the A. W. S. Papers 24
Welding in the Fabrication of Thin Stainless Steel Sheets .. 31
Spot Welding vs. Die Casting 32
Some Helpful Hints on Boiler Firebox Welding 33

Index to Advertisers 8
What's Here? 11
Editorial 15
Brief Sketches of Welding Jobs 36
The Technical Slant 38
New Product Developments 40
News of the Industry 43
Personal 44
Engineering Data Sheet No. 2 45
Trade News 47
Obituary 47
Current Reviews 49
Recent Patents 50
Classified Section 53

Subscription, payable in advance: United States and possessions, and Canada, $3 a year: Foreign Countries, $4 a year; Single copy, domestic, 25 cents; Single copy, foreign, 35 cents. Copyright, 1940, by Welding Engineer Publishing Co. Entered as second-class matter January 20, 1916, at the postoffice at Chicago, Illinois, under the act of March 3, 1879.

FOREIGN REPRESENTATIVES: AUSTRALIA and NEW ZEALAND—R. Hill, Matlock House, Davenport, Auckland, New Zealand; GREAT BRITAIN—A. D. Baynes, 1 Cambridge Park Court, Twickenham, Middlesex, England; SOUTH AFRICA—J. W. Arnison, 35a Victoria Avenue, Benoni, Transvaal, South Africa; JAPAN—Maruzen Company, Ltd., 6, Nihonbashi, Tori-Nichome, Tokyo, Japan; U. S. S. R.—Mesdunarodnaja Kniga, Kusnezki Most 18, Moscow, U. S. S. R.

NO. 4 OF A SERIES SHOWING HOW STOODY SAVES YOU MONEY:

WHETHER YOU MAKE SUGAR OR OPERATE A RIDING ACADEMY

Stoody

SAVES YOU MONEY!

Sugar mills and riding academies may be two widely different types of businesses, but both use Stoody hard-facing metals to cut costs.

In the sugar industry Borod is applied to the plow shares, cultivator shovels, shredder knives and rolls to retard wear and reduce operating costs. Riding academies also hard-face their horseshoes to retard wear, but an equally important reason for applying the hard metal is to prevent horses from sliding or falling on hard slippery road surfaces. One-quarter inch diameter 8-10 Acetylene Tube Borium is used for this application because the Borium particles in this rod are large enough to grip into pavement.

Perhaps some part of your equipment wears rapidly. Your Stoody distributor can tell you whether or not hard-facing is the solution to your problem and, if so, which of the ten Stoody hard metals should be applied for best results. Why not call him today?

STOODY COMPANY
WHITTIER, CALIFORNIA
★

What's Here?

GENERAL

The constant demands for increased production in the aircraft field has resulted in many problems in this industry. Hanford Eckman's article on page 17 recounts some of the problems encountered in welding light aircraft and includes some interesting metallurgical data obtained from a study to speed up production. Consequently, plane production was increased from 100 planes a year in 1931 to 323 for the month of June 1940 alone.

» «

GENERAL

The high spots of the 21st Annual Meeting of the American Welding Society at Cleveland are given on page 22. This proved to be the greatest welding meeting to date. There were presented, during the 15 technical sessions, 53 papers some of which are included in digest form (page 24) in this issue.

» «

DESIGN

Engineering Data Sheet No. 2 presents in chart form, for ready reference, information of interest to those using welding in structural steel construction. (See page 45.)

ALLOY

Welding thin stainless steel sheets present some interesting problems. It is readily done by atomic hydrogen as is explained in an article on page 31. In this case some of the welding was on stainless sheets only 0.015 in. thick. Seven distinct operations are required to polish the finished product.

» «

MAINTENANCE

While welded boilers are coming into more widespread use, welding as a means of boiler maintenance is still questioned. On page 33 there are some helpful hints on boiler repairs that have been proved —proved by actual application in the maintenance of locomotive boilers.

» «

DESIGN

Spot welding (page 32) is replacing die casting as a means of rapid assembly. Radiator grills are made at the rate of 50 per hour by this novel assembly welding setup.

What's Coming?

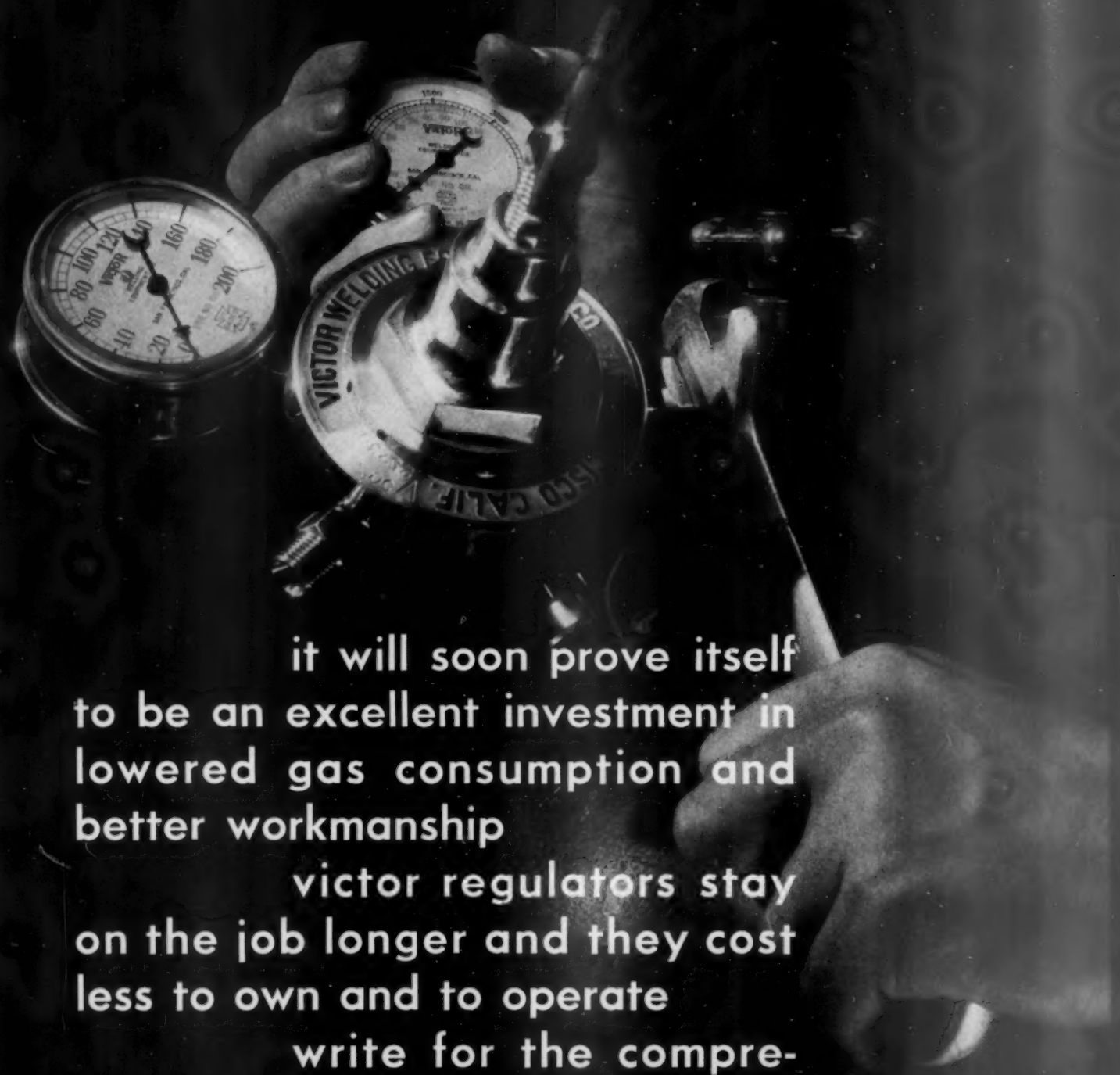
The proper design and production set up will not only increase production but reduce cost in our National Defense Program. In an article in the next issue, a noted consultant on welding for production will give pointers on "tooling-up" for automatic welding of wheels for military tanks.

» «

Another December feature "Welding Fire Hazards" will bring the readers of The Welding Engineer timely information as well as startling facts regarding welding fires.

In the same issue there will also appear "Positioners Promote Economy" by Robert Lattice, along with other timely articles on all phases of welding.

attach a victor safety regulator



it will soon prove itself to be an excellent investment in lowered gas consumption and better workmanship

victor regulators stay on the job longer and they cost less to own and to operate

write for the comprehensive victor regulator catalog

victor equipment company, 844-50 folsom street, san francisco

distributing points from coast to coast

Theodore Roosevelt's Last Words*

I CANNOT BE with you, and so all I can do is to wish you godspeed. There must be no sagging back in the fight for Americanism, merely because the war is over. There are plenty of persons who have already made the assertion that they believe the American people have a short memory and that they intend to revive all the foreign associations which most directly interfere with the complete Americanization of our people. Our principle in this matter should be absolutely simple. In the first place, we should insist that if the immigrant who comes here does in good faith become an American and assimilates himself to us he shall be treated on an exact equality with every one else, for it is an outrage to discriminate against any such man because of creed or birthplace or origin.

But this is predicated upon the man's becoming in very fact an American and nothing but an American. If he tries to keep segregated with men of his own origin and separated from the rest of America, then he is not doing his part as an American. There can be no divided allegiance here. Any man who says he is an American, but something else also, is not an American at all.

We have room for but one flag, the American flag, and this excludes the red flag, which symbolizes all wars against liberty and civilization just as much as it excludes any foreign flag of a nation to which we are hostile. We have room for but one language here, and that is the English language, for we intend to see that the crucible turns our people out as Americans, of American nationality, and not as dwellers in a polyglot boarding house, and we have room for but one soul loyalty, and that is loyalty to the American people.

* * *

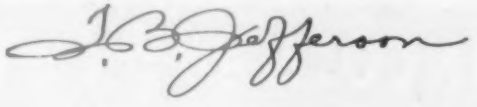
These words of T. R. are probably more applicable today than they were 20 years ago. Today, in the rush of defense preparations, we have many subversive elements — Fifth Columnists, saboteurs and others that are endeavoring to impede our progress.

As Samuel B. Pettengill writes in his book, "Smoke Screen," a book that lifts the smoke screen around America's fifth column, "Even the poorest American believes in the Constitution of the United States; believes in private ownership of property and the profit motive; believes that investors are entitled to fair treatment; believes the law should place no limit to the reward of honest achievement.

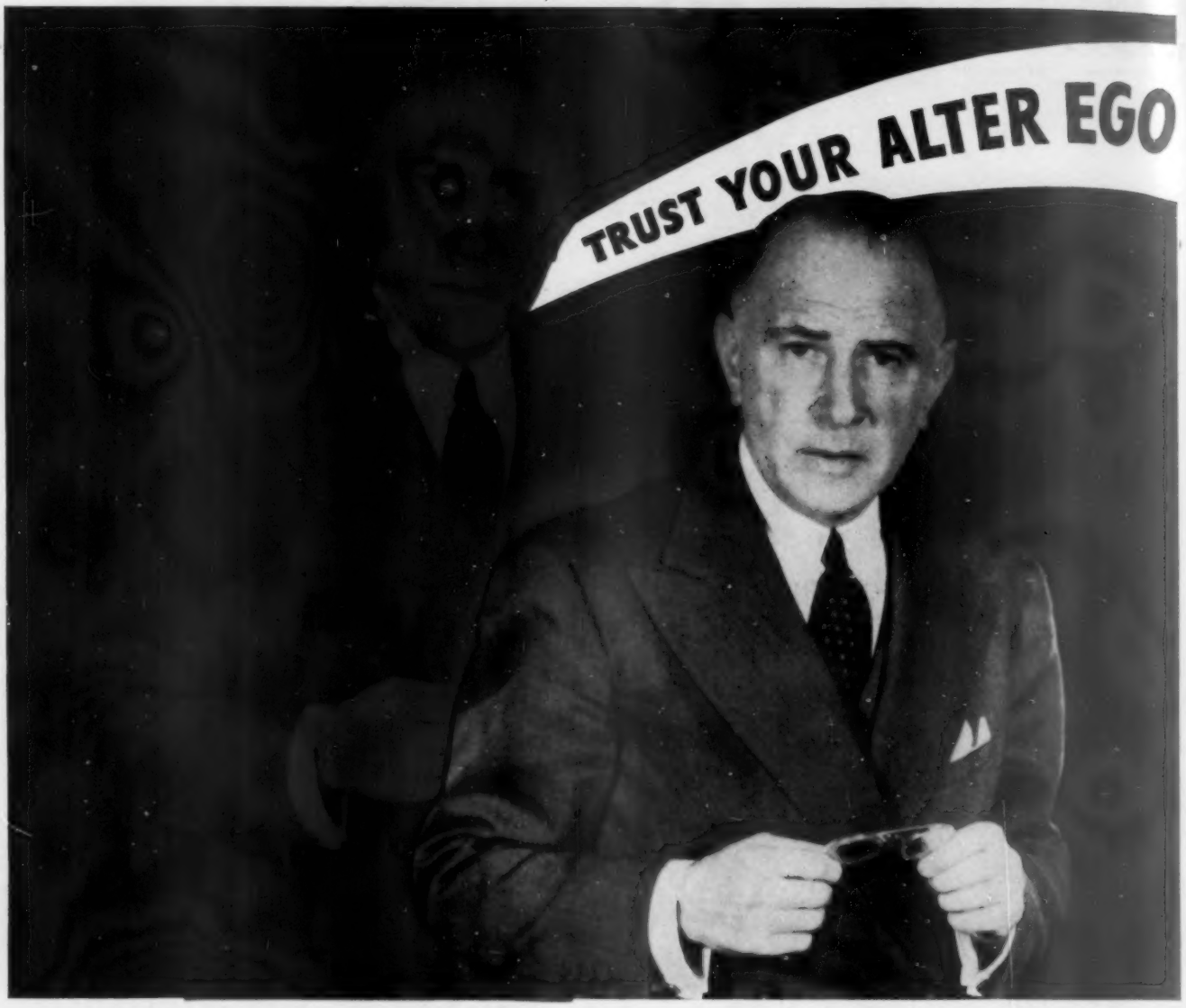
"Here is something to build on. The American people are not communists. The time and opportunity have come to all of us, but particularly to those in posts of responsibility and stewardship to resell America to Americans in the American Home Market. IT CAN BE DONE! All we need are a few salesmen with just a part of the spunk that lifted the words 'Washington,' 'Jefferson' and 'Lincoln' out of the shadows."

* * *

Let's keep America for Americans.



*Reprinted from Feb. 1920 issue, The Welding Engineer



ALTER EGO: Literally "one's other self"—the still, small voice that questions, inspires and corrects our conscious action.

ALTER EGO: Let's talk things over. As your other self, I feel it my duty to give you some advice on how to improve your product and cut its cost.

Well, you're one fellow I don't mind getting advice from. I know you won't try to sell me something.

ALTER EGO: All right. Here's my suggestion. First, improve your reasoning technique. Learn to *trust your Alter Ego*. Listen to that inner voice more often.

All right, but I've had to use my conscious mind so much to ward off exposure to arc welding salesmen that I've got in the habit of trusting my surface judgment.

ALTER EGO: Yes, and because of surface reasoning you're too prone to deride that which you don't sufficiently understand. Look how others are profiting with arc welding.

But how can I understand arc welding without opening up to sales exposure?

ALTER EGO: I understand that Lincoln is a good source for arc welding information that's devoid of your pet aversion. Not a high-pressure sales talk in a book-full.

• •

LINCOLN SUGGESTS: To better acquaint yourself with arc welding procedure, why not obtain an informative discussion of this metal working process as applied to *your* problems? Lincoln's booklet, "101 Welding Ideas" gives the facts.

LINCOLN "SHIELD-ARC" WELDING THE LINCOLN ELECTRIC COMPANY Cleveland, Ohio

Authoritative Information on Design • Production • Welding Equipment

★ GENERAL

Oxy-Acetylene Welding of Light Aircraft

★ Welding is playing an important part in the manufacture of light airplanes. The metallurgy of chrome-moly welding and the advantages of an excess acetylene flame fully described.

By

Hanfold Eckman

Production Manager and Superintendent, Piper Aircraft Corp. Lock Haven, Pa.

THE LIGHT PLANE, by definition, is one that has an engine of 75 hp. or less. It is also recognized as having a high ratio of weight to power (power loading) and a low ratio of weight to wing area (wing loading). In the light plane field, perhaps even more than in the balance of the aircraft manufacturing industry, mass-production principles, as practiced for example in the automotive industry, do not generally apply. True, these principles do play an important part in many of the outside sources of supply, such as among the engine makers, and automatic machines also help to reduce hand operations. The present light plane, though, is still, in large part, a handmade product in the creation of which welding plays a prominent part.

This article will be confined to the use of oxy-acetylene welding in the production of light planes, designed principally for private use as differentiated from military and commercial aircraft of higher performance. In this field, the welding of light-walled tubing is practiced most extensively in the fabrication of fuselages. For the light plane, welded tubular design at present allows the most satisfactory method of construction because it permits a high rate of production with a minimum of special tools and jigs.

Welded tubular design has a high ratio of strength to weight. Moreover, welded joints are highly efficient and rigid, and, at the same time, light in weight. This type of assembly permits great flexibility of design and is economical to fabricate and to maintain.

Construction Developments

Perhaps a review of the development of welded tubular construction in the aircraft industry will help to indicate present trends in design and materials. When metal first replaced wood in aircraft members, carbon steels were employed. These are still used, as represented by the S. A. E. 1025 or similar steels. Joint design and welding technique for this material were thoroughly investigated both in the field and in the laboratory. As the industry developed, higher speeds were attained in aircraft and greater stresses resulted. In the search for lighter or stronger materials, alloy steels were introduced. S. A. E. 4130 and S. A. E. X4130 or their equivalents have been widely used.

There are a number of specifications written to cover carbon steels and chromium-molybdenum steels in various industries, and particularly in the aircraft industry. The following table is representative of

Physical Properties

		Minimum Tensile Strength, lb. per sq. in.	Elongation, per cent in 2 in.
S.A.E. 1025		55,000	22
S.A.E. X4130, normalized		*90,000-95,000	*5-15
S.A.E. X4130, oil-quenched	Approx. tempering temperature, deg. F.		
	1,100	*125,000	*11
	900	*150,000	* 9
	800	*175,000	* 7
	600	*200,000	* 5

* Light gauges—minimum ductility—maximum tensile strength.

Chemical Composition

	Carbon, %	Manganese, %	Chromium, %	Molybdenum, %
S.A.E. 1025	0.20-0.30	0.30-0.60		
S.A.E. X4130	0.25-0.35	0.40-0.60	0.80-1.10	0.15-0.25

* Paper presented at the Twenty-First Annual Meeting of the American Welding Society, October 20 to 25, 1940, Cleveland, Ohio.

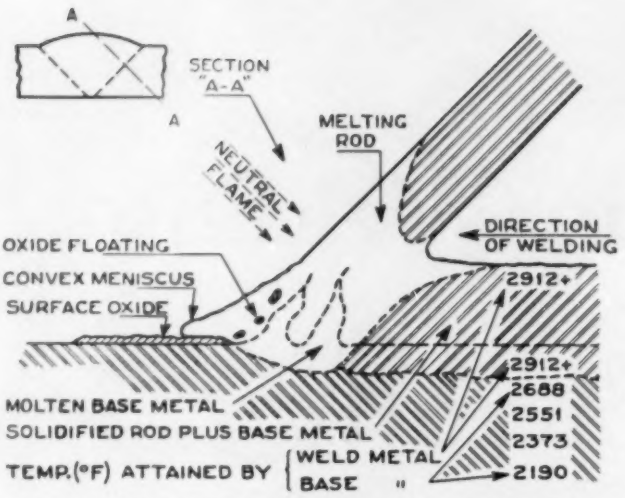


Fig. 1—This sketch indicates the metallurgical factors in neutral flame welding.

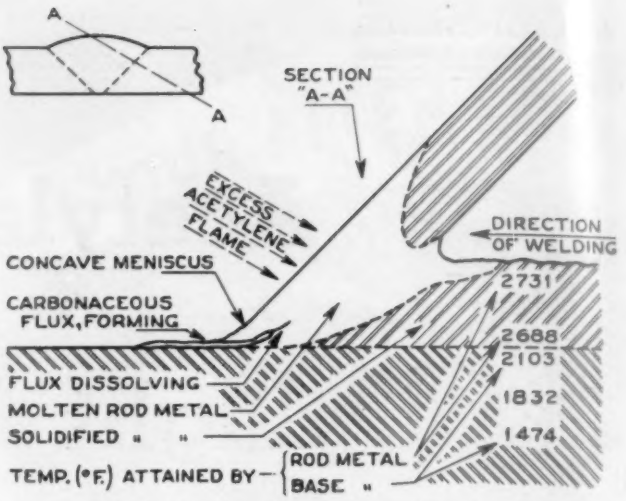


Fig. 2—This sketch indicates the metallurgical factors in excess acetylene welding.

these steels. It will be of assistance in making a comparison of the physical properties of the chromium-molybdenum and the carbon steels.

The most noticeable differences in physical properties between chromium-molybdenum steels and plain carbon steels are found in the relative tensile strength and ductility. The chromium-molybdenum steels, because of their greater strength and ductility, are highly suitable for use in aircraft construction. These alloy steels also offer greater possibilities of heat-treatment. This and the fact that they air-harden have necessitated certain changes in welding technique. A discussion of some of the significant factors in welding, which are common to welding both plain carbon steel and chromium-molybdenum steel will help to trace the development and to show the advantages of present-day technique.

Metallurgy of Welding Plain Carbon Steel

As steel is heated it undergoes several alterations of physical properties. When the temperature is increased, the steel expands, becomes softer and more ductile, and, particularly at elevated temperatures, becomes weaker from the standpoint of tensile strength. It is fortunate from the viewpoint of the fabricator that these changes in physical characteristics are coincidental, because the collective phenomena make possible the joining of several members into a high-strength structure by means of fusion welding. When heat is applied locally, expansion takes place in the heated zone; but because the ductility is increased, the area over which the stresses are distributed is increased, and the material does not rupture. Of course the piece should be free to move sufficiently to absorb expansion and contraction, so that no undue stress is put on the hot, low-strength material.

When heat is continuously applied, the temperature rises to a series of recalescence points. In plain carbon steels these start at about 1,360 deg. F. The metallurgical changes that take place here have a very practical significance. The carbon, which at lower temperatures has existed as discrete particles of iron carbide mixed with pure iron, goes into solution in the iron and remains in solid solution at temperatures above this point. On cooling slowly through this temperature, the carbon is again precipitated or thrown out as iron carbide. More rapid cooling tends to retard the reaction and to retain the carbon in solution.

Recrystallization takes place at about the same temperature as recalescence. When heated much above the critical point, steel crystals tend to grow in size to an extent depending on the length of time at the temperature and the amount the temperature exceeds the critical point. The shorter the time that the steel is held above the critical point and the lower the temperature, the finer the crystals will be and the better the physical properties.

That steel reacts with oxygen at all temperatures is illustrated by the rusting action at ordinary temperatures and by the adherent oxide scale that is found on hot-rolled or forged stock. When stock is reheated, the carbon in the adjacent steel begins to react with the iron oxide. The oxide is reduced and the products of the reaction escape as a gas. Migration of carbon is rapid and decarburization may proceed to a considerable depth. The reaction is accelerated as the steel becomes molten.

In oxy-acetylene welding, the surface of both the base metal and the welding rod become coated with iron oxide or scale while heating up to welding temperature. Further, the iron oxide has a lower melting point than steel and must be removed to secure a sound weld.

Welding Chromium-Molybdenum Tubing

These physical, metallurgical and chemical factors in welding become more significant with the wider use of alloy steels. They are of considerable importance in welding light-walled chromium-molybdenum tubing. The air-hardening qualities and resulting high tensile strength and reduced ductility indicate that more attention has to be given to expansion and contraction of the steel, and to insuring that undue stress is not placed on the hot metal. Though molybdenum is present to inhibit grain growth, it is desirable to reduce the temperature and the time that the steel is held above the critical point to a minimum. Furthermore, with thin-walled tubing, decarburization of a very small portion of

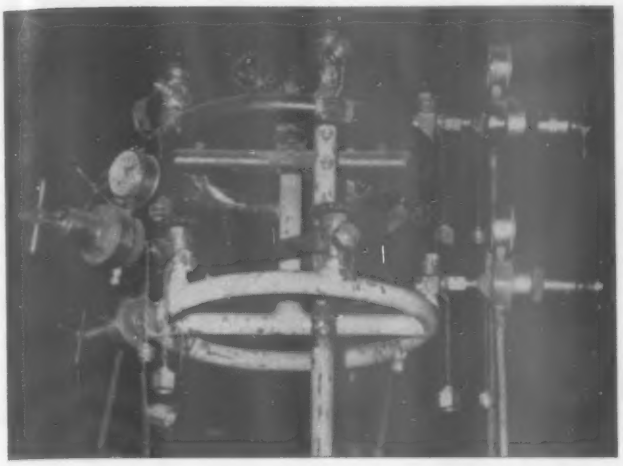


Fig. 3—Floor space is conserved by supplying oxygen and acetylene to welding stations through drop rings.

the wall thickness affects an appreciable precentage of the area of the cross section. To obtain efficient joints in the alloy steel, the welding rod must have a tensile strength comparable to that of the chromium-molybdenum tubing and welds made with it must react favorably to heat-treatment.

Welding Rods

The first oxy-acetylene welding rods which gave good quality welds were low in carbon and contained a minimum of other elements. This was reflected in the welding technique used. To obtain adhesion between the added metal and the base metal, a considerable amount of the latter was melted to make sure the oxide was removed. To eliminate the iron oxide from the weld, the weld metal was heated well above melting temperature to obtain fluidity. As a result the weld was reduced in carbon and was low in tensile strength as compared with the results obtainable today. The carbon content of the rod had to be low to avoid excessive reaction between it and the large amounts of iron oxide that were present.

As the welding industry has developed and knowledge of the needs and problems has increased, new welding rods have been devised in which manganese and silicon have been added to reduce the iron oxide. With these, the products of the reaction are solids which form a fluid slag that floats to the top of the molten puddle. This effectively cleans the weld metal and protects it from further oxidation. The elimination of the carbon-iron oxide reaction in the weld makes it possible to increase the carbon content of this type of rod. Consequently the strength of the weld is increased and a sounder deposit is obtained. The active reducing agents readily remove the oxides, thereby making excessive melting of the base metal or temperatures much above melting point unnecessary. The welding technique, though, is still very similar and a neutral flame adjustment is used.

Fig. 1 illustrates the action of the welding puddle. The temperatures are representative of those obtained in a cross section of a weld. This type of welding rod and welding technique is widely used in the fabrication of tubular members. It is very satisfactory when used on straight carbon steels as with S. A. E. 1025 and good results are obtained with some chromium-molybdenum steels, particularly if care is taken to allow for expansion stresses and if heating is held to a minimum to inhibit grain growth. A later advance in welding procedure has further assisted in the welding of chromium-molybdenum tubing.

The newer process for oxy-acetylene welding utilizes certain distinct but co-operating properties of carbon and iron. The underlying principle of the process is comprised of the following relations: carbon is soluble in iron; carbon lowers the melting point of the mixture; this melting point is in the feasible welding temperature range; carbon reduces iron oxide; the non-metallic product of the reaction is gaseous and escapes.

If a piece of steel is heated to somewhat below welding temperature and is exposed to a carburizing influence, the surface layer of the white-hot metal will absorb carbon and will melt spontaneously as the carbon approaches the eutectic mixture of 4½ per cent. This carbonaceous film does three things essential in welding. It prevents oxidation and reduces oxides. It promotes intimate contact by acting as a flux and causing the molten metal to run out over the melted surface. It acts as a temperature indicator denoting by its formation the proper time to add weld metal.

Excess Acetylene Flame

Fortunately from the standpoint of commercial feasibility, the carburizing agent is available in the standard oxy-acetylene welding equipment by proper adjustment and manipulation of the flame. As a weld progresses, carbon is absorbed to a depth of one or two thousandths of an inch on the sur-

Fig. 4—The chrome-moly tube fuselages are first tack welded in jigs.

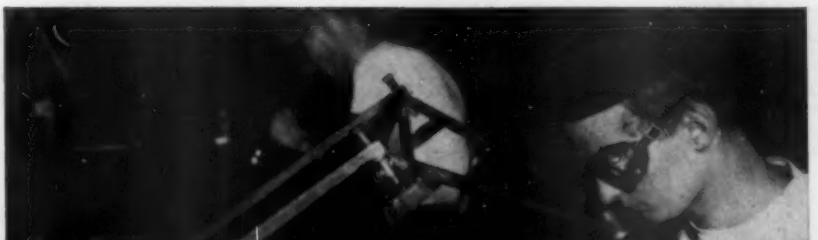


Fig. 5—This motor mount is fabricated by welding Chromium-Molybdenum in tubing.

face of the steel and melts spontaneously. The blow pipe is manipulated so that the carbonaceous film covers the base metal adjacent to the welding puddle.

This film has certain unique features. It is metallic. It is produced automatically. It melts spontaneously, and it disappears by dissolving into the weld metal as soon as its functions are fulfilled. The action may be termed "self-fluxing."

The process is known descriptively as excess acetylene welding. Considered in terms of its application to welding on chromium-molybdenum tubing, this process offers a number of advantages over the neutral flame method. It is faster. The indication of proper welding temperature by the spontaneous formation of the carbonaceous film permits more attention to be given to rod manipulation and the rod may be deposited more rapidly. Welding is carried on at a lower temperature. Fig. 2 shows representative temperatures of various sections of a weld when this technique is employed.

Grain Growth Control

The combination of faster welding and welding at a lower temperature reduces the tendency towards grain growth, as the time and the temperature at which the steel is held above the critical point are both reduced to a minimum. Reduced grain growth means improved physical properties.

The amount of expansion varies with the speed of welding. In general, the faster the weld the less the expansion that takes place, and the lower the resulting stresses. In general, a backhand technique will result in slightly less expansion stresses than a forehand technique. The excess acetylene welding process thus assists in overcoming expansion and contraction problems.

The carburizing or reducing atmosphere properly controlled by the excess acetylene flame tends to eliminate a decarburized surface on the tubing at the weld. The external supply of carbon tends to maintain the carbon in equilibrium in the steel, as it is not required to reduce the surface oxides. Carbon loss by migration is avoided.

This welding process reduces the probability of disturbing the chromium-manganese-carbon ratio of the steel immediately adjacent to the weld. The balanced composition proportioned to give optimum relationship between strength and ductility is maintained. When a suitable rod and the excess of acetylene welding technique have been used, physical properties may be obtained by heat-treatment equivalent to those of the original material. On fittings and small assemblies, heat-treatment is desirable with the chromium-molybdenum steels. On larger assemblies it is often impracticable. In either case the excess acetylene welding process assists in obtaining better welds.

Still another item might be mentioned. Due to the semi-automatic features of this process it can be used readily with either a forehand or backhand technique. The physical properties of chromium-molybdenum tubing in the normalized condition vary somewhat. Very light-walled tubing tends to cool rapidly and a higher tensile strength and lower ductility is obtained with the air-hardening properties of the steel. A backhand technique may be utilized to reduce the quenching effect where it is desirable to do so.

Welding Applications

Up to this point we have discussed, at some length, the basic problems and metallurgy of welding chromium-molybdenum tubing by the oxy-acetylene process. This is because the greatest amount of welding is done on this material. In our plant, we use about 85 different sizes of tubing ranging from ¼ in. to 2 in. in diameter. Wall thicknesses vary from 1/64 in. to ⅛ in. Stock tubing, received in lengths of from 12 to 20 ft., is cut to size and then shaped for assembly.

At this stage of production, welding is encountered for the first time. The various jigs used for holding the tubing during the shaping operations are fabricated in the tool department by bronze-welding, a process which is particularly effective for this type of work because of its great flexibility and speed. The various tubular

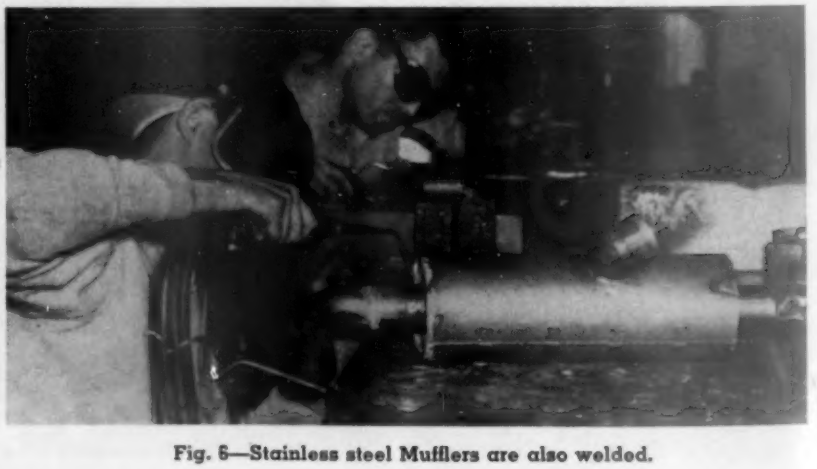


Fig. 6—Stainless steel Mufflers are also welded.

members are transported to the adjacent fuselage and bench welding departments for fabrication into component aircraft parts. Manifolded oxygen and generated acetylene are supplied through a piping system which terminates in a number of strategically located drop rings similar to the one shown in Fig. 3. These drops provide at present for a total of 124 separate welding stations, all of which are so positioned as to provide a maximum effective working range for each operator. In addition, the method of suspension from above conserves valuable unobstructed floor space all the way along the line.

In the fuselage department the shaped sections of tubing are first set up in jigs for tack-welding. General views of this stage of construction shown in Fig. 4. The jigs are reasonably heavy, rigid construction and were designed along three basic principles: (1) they provide for exact positioning of the tubular members and for clamping them in place until they are joined; (2) wherever there is a possibility of unfavorable warpage taking place, provision is made for keeping the body of the metal cool during welding; and yet (3) their construction is such as to prevent the edges to be joined from becoming unduly chilled.

On completion of the tack-welding operations, the fuselages are mounted fore and aft in wheeled dollies like that shown in Fig. 7, and passed along to the finish-welding section of the fuselage department. Here all tack-welds are finished by experienced operators. Their task is facilitated by rotating the entire fuselage in the dolly in order to take advantage of the best possible welding position for each joint.

The total number of steel welds in clusters, fittings and turtle decks in a given airplane varies according to the model, but the average number is close to 150. Additional bronze-welds for some of the smaller fittings, guides for control cables, and other similar parts average over 200. In these latter operations, production has been considerably speeded by use of the vapor flux dispenser. This piece of equipment is connected between the regulator or hydraulic back-pressure valve and the blowpipe so

Fig. 7—This dolly is designed to permit positioning of the fuselage for welding.

that all of the acetylene used passes through the dispenser. The acetylene, as it flows toward the blowpipe, bubbles through a special liquid flux within the dispenser and picks up the required amount of flux in vapor form. The vapor flux then passes through the hose and blowpipe directly to the point of welding where the required fluxing is produced upon the parts being joined. Application of the flux is thus automatically and mechanically controlled. Only the required amount of flux is deposited at the exact point where it is needed so that waste, due to excessive use of flux, is eliminated, and sound bronze welds of excellent appearance are speedily obtained.

Bench-Welding Applications

As the fuselages are being constructed, the bench welding department is busy fabricating fittings and hundreds of small assemblies. The necessary operations here include fusion welding of chromium-molybdenum and stainless steel, and bronze-welding. The operator in Fig. 5 is welding a chromium-molybdenum steel motor support. Other parts welded from this material include axle assemblies for landing gears, control stick torque tubes, fire-wall supports, wing compression webs, tail-surface assemblies, including elevators, rudders, fins and stabilizers, bell-crank brackets, and many other parts. Stainless steel welding on present models is confined to mufflers (Fig. 6), auxiliary fuel tanks, and exhaust manifolds.

Our assembly operations, in a plant with an area of 140,000 sq. ft., cannot be called strictly straight-line because two floors are used. However, major assemblies are moved through the shop by means of an overhead conveyor system which terminates in the final assembly department and our layout is organized so that all assemblies, subassemblies, and single parts arrive in the various departments at the precise moment to insure smooth production. Our potential capacity is about 600 planes a month.

Conclusion

In summarizing, it would seem that welded tubular design at the present moment is still the most satisfactory method of construction for light airplanes. In fabrication of component parts from the widely employed chromium-molybdenum tubing, welding by the excess acetylene method has largely supplanted fusion welding by the neutral flame for several important reasons. The excess acetylene method is faster and it permits more attention to be given to rod manipulation. Welding is carried on at a lower temperature, thereby resulting in reduced grain growth with corresponding improved physical properties in the weld. Because the newer process is adaptable to either the forehand or the backhand technique, it can assist materially in overcoming expansion and contraction problems. Finally, the carburizing or reducing atmosphere of the excess acetylene flame tends to eliminate a decarburized surface on the tubing at the weld.

A second important aid in speeding the production of light planes is the vapor flux dispenser previously described. This piece of apparatus makes fluxing for bronze-welding completely automatic by mechanically delivering the exact amount of flux at the actual point of welding and at the precise moment it is needed, thus greatly eliminating the human element in this respect. The regular results are bronze welds spedily made and which are uniformly sound and of excellent appearance.

Highlights of the Annual A. W. S. Meeting

Retiring A.W.S. president George T. Horton looks on while first vice president T. C. Smith awards the prizes in the Resistance Welders Manufacturers' Association contest. Those present from left to right are: President Horton, J. Tampico, J. H. Cooper, A. M. Unger, H. A. Matis, W. A. Knocke, R. S. Pelton and Vice President Smith.

THE 1940 Metal Congress and Exposition and the twenty-first annual meeting of the American Welding Society which were held in Cleveland, October 20-25, both proved to be record-breakers. The Metal Exposition with its 338 exhibitors occupying 103,000 square feet of exhibition space is the largest that has been held to date. In a similar manner a total registration of 1683 set a new all-time attendance high for the annual meetings of the American Welding Society. During the 15 technical sessions there were presented 53 papers; in addition, there was a session for the presentation of awards, industrial research conference, fundamental research conference and the annual business meeting.

Presentation of awards was the feature of the opening session. The Samuel Wylie Miller memorial medal was awarded to William Spraragen, technical secretary of the American Welding Society and editor of *The Welding Journal*, "for conspicuous contributions to the art and science of welding during 21 years in the field."

H. J. French and T. N. Armstrong Jr., International Nickel Co., New York were joint recipients of the Lincoln gold medal donated by James F. Lincoln, president, Lincoln Electric Co., Cleveland. This award is presented each year for the paper which contributes most to the year's development of welding and was made for their paper 'Weld Hardening of Carbon and of Alloy Steel," which was presented at the 1939 annual meeting.

A new series of awards presented this year for the first time and scheduled for subsequent years were those offered by the Resistance Welder Manufacturers' Association, 505 Arch St., Philadelphia. Awards this year included: First Prize, $300 — for paper "Electro-Magnetic Stirring Action in a Spot Weld," by A. M. Unger, H. A. Matis, W. A. Knocke, Pullman Standard Car Mfg. Co.; Second Prize, $200 — for paper "Fundamentals of Resistance Welding," by R. S. Pelton, General Electric Co.; Third Prize $100 — for paper "Resistance Flash Welding of Strip in Steel Mills," by J. H. Cooper, Taylor Winfield Co.; 4 Fourth Prizes, $25 — for paper "Application for Pulsation Welding Broaden the Field of Resistance Welding," Part III by H. C. Cogan, National Electric Welding Machine Co. and R. S. Pelton, General Electric Co., $25 — for paper 'Spot

Dr. D. S. Jacobus presents the Miller Memorial Medal to William Sparagen.

Welding in Aircraft Construction," by C. F. Marschner, McDonnell Aircraft Corp., $25 — for paper "Electro-Brazing Methods," by R. J. Wensley, I. T. E. Circuit Breaker Co., $25 — for paper "Measurement of Contact Resistance" by W. B. Kouwenhoven, Prof. E. E., Johns Hopkins University and J. Tampico, graduate student.

Three New Sections

At the annual business meeting, retiring Society president, George T. Horton, Chicago Bridge & Iron Co., Chicago, announced that during the past year three new sections were organized at: Manitowoc, Wis., Newark, N. J., and the Canal Zone. During the same period the total membership of the American Welding Society had increased to 4344, an increase of 651 members for the year.

New Committees Organized

Four new committees were organized to cover: (1) Non-Destructive Tests for Welds; (2) Inspection of Welding; (3) Electric Welding Apparatus and (4) Codes for Fusion Welding High-Alloy Steel Engineering Structures. In addition, the following committees were reorganized so that they might continue functioning: (1) Building Code; (3) AWS - ASME Conference Committee; (3) Standard Tests for Welds; (4) Grouping of Materials According to Weldability; and (5) Minimum Requirements of Instruction for Welding Operators in Trade Schools. Representatives of the Society were also appointed on the ASA standardization project "Preferred Voltages — 100 Volts and Under"; ASTM Committee A10 — Subcommittee VII on welding, and American co-ordinating committee on corrosion.

Codes Completed

Those committees working on the following codes completed their work during the year: (1) Tentative Standard Methods for the Mechanical Testing of Welds: (2) Tentative Definitions of Welding Terms and Master Chart of Welding Processes (3) Tentative Rules for Field Welding Storage Tanks; (4) Tentative Specifications for Iron and Steel Arc Welding Electrodes (5) Welding Symbols and Instruction for Their Use: (6) Recommended Procedure to be followed in Preparing for Welding or Cutting Certain Type of Containers which have held Combustibles; (7) AWWA — AWS Tentative Specifications for Elevated Steel Water Tanks, Standpipes and Reservoirs; (8) Standard Qualification Procedure — Section 1 — Manual Arc and Gas Welding of Ferrous Materials; and (9) Welding of Pipe Joints.

» «

A.I.S.C. Bridge Design Construction

The American Institute of Steel Construction announced today another annual bridge design competition, open to bona fide registered students of structural engineering and architecture in recognized technical schools of the United States and its possessions, and offers three cash prizes of $200, $100 and $50 respectively, for the designs placed first, second and third. Certificates, signed by the Jury of Award and the Officers of the Institute, will be awarded to the prize winners and to those whose designs are given honorable mention. The premiated designs will become the property of the Institute.

The subject of the competitive design is a steel overpass bridge to carry a single track railroad over a highway. The structure shall provide for a clear width of 16 feet between parapets. Steel railings or parapets are to be provided of a total height above the base of rail of 44 inches. The required underclearances above the surface of the highway below is 14 feet 6 inches for full length of the span. If desired, columns may be placed at the curb lines of the two 8 foot sidewalks on the highway over which the bridge crosses. A clear space must be left for pedestrians using either sidewalk. No provision for lighting is to be made. The student may assume that ample funds are available with which to build an efficient structure of good appearance, but no money is available for expensive decoration or masonry. It is suggested that appearance shall be obtained by a proper use of form. The structure must be of steel, including the railings, but not including abutments.

A jury of nationally known engineers and architects will judge the competition on February 19, 1941. Drawings must be received at the Executive Offices of the American Institute of Steel Construction, 101 Park Ave., New York City, not later than February 10, 1941.

» «

T. N. Armstrong and H. J. French are presented the Lincoln Gold Medal by Prof. L. W. Clark.

A Digest of Some of The A.W.S. Meeting Papers Presented at Cleveland

★ At the Twenty-first Annual Meeting of the Society there were presented a variety of technical papers. The following summaries of papers review a few of the 53 papers that were given.

Welding in Shipbuilding

By DAVID ARNOTT*

★ This paper traced the development of ship construction from the wood ship era pointing out that the trend has been towards simplicity of design and economy of material by the gradual elimination of parts more or less redundant and by reduction in scantlings made possible by superior distribution of material. Emphasis is placed on the fact that the method of fastening the various parts of the ship have been the main source of trouble in service both in wood and steel riveted ships, it being impossible to work in sufficient fastenings to develop the full strength of the material. A high degree of efficiency in the design and construction of riveted ships had, however, been reached as a result of the application of scientific principles to their design and a close observation of ships in service, so much so that prior to the present extensive use of welding it had become difficult to conceive of any further major reduction in scantlings or improvements in structural design that could be effected without the use of special and more expensive steels. The advent of welding in ship construction has opened up an entirely new vista in respect that a new tool is now available for the production of more efficient and more economical hull structures. The earlier welded ships were, as one would expect, merely riveted designs welded so that the maximum economies from the use of the new process were not at once achieved. Oil tanker owners were the first to grasp the significance of advantages of welding which are readily apparent such as saving of weight and increased deadweight, superior oiltightness, less liability to cargo damage in service, easier cleaning of tanks, and cheaper repairs so that the earlier all-welded ships built in this country were mostly of the small tanker type. These ships have given a good account of themselves under service conditions and so far have been remarkably free from serious structural troubles. Welding is now being employed in the construction of the larger ocean-going type vessels where the service stresses are relatively much higher and it is emphasized that for these important and complicated structures the best welding is none too good if trouble is to be avoided throughout the service life of the ship.

Considerable information were given with regard to the amount of Welding being done in United States shipyards. Practically all vessels under 300 feet in length, i.e., small tankers, barges, towboats, etc., now building to American Bureau classification are of welded construction. Of the larger ocean-going vessels now building or under contract to A. B. S. classification, on September 1, 1940, 177 in all, no fewer than 41 are all-welded, 135 are part welded or rather part riveted, and only one a large car-ferry building on the Great Lakes can properly be termed a riveted vessel. It was claimed that these remarkable figures not only represent a considerable achievement on the part of our shipyards but reflect the increasing confidence in the structural efficiency of welded ships and the realization on the part of our shipowners of the many advantages to be gained by the new method of construction.

The comparative cost of welded and riveted construction were discussed and it was pointed out that so far as barges are concerned it can be stated quite definitely that there is a decided saving in initial costs for the welded barge as compared with the riveted barge of the same type and this is borne out by the fact that our river yards are now building welded barges almost exclusively. The comparative cost of riveting and welding in the case of the larger ocean-going type ships is more elusive depending on the facilities of the particular shipyard such as available storage and assembly spaces, crane capacities, welding equipment, method and sequence of preparing sub-assemblies, etc., etc. The cost of the welded ship will, however, tend to reduce as time goes on and as experience is gained in ship welding.

The present trend of manual welding in our shipyards is towards the use of larger electrodes and heavier currents and to use continuous welding rather than intermittent. It is also a tendency to lay more stress on the testing and approving

*Vice-President and Chief Surveyor, American Bureau of Shipping.

of processes and towards a simplification of tests for the so-called qualification of the Welding Operator which is all to the good. Our shipyards are continually experimenting with various types of automatic equipment and approved applications of the various processes may be confidently anticipated.

The paper was concluded with a plea for financial support on the part of the shipyards for the important work being carried out by the Research Committee of the American Welding Society.

» «

Carbon-Molybdenum Piping

By R. W. EMERSON,*

★The author pointed out that the service requirements of power plant piping in 1915 were seldom higher than 200 lbs., 500°F., by 1930, a period of 15 years, these requirements were raised to 1300 lbs., 750°F., today steam power plants are operating as high as 1800 lbs., 950°F. In view of this fact it is not surprising that power plant materials and their subsequent fabrication must pass rigid specifications and inspection.

He continued his discussion of the effect of molybdenum on steel, the metallurgical effects produced by welding heat, the effect of preheating and stress relieving on qualification test results, joint designs for high pressure piping, and concludes with general procedure and operator qualifications.

The paper may be summed-up with the following conclusions:

Carbon-Molybdenum Steel is welded using an electrode of the same approximate analysis as the base material; for this reason, the main metallurgical consideration is the effect of the welding heat, followed by rapid cooling, on the hardness and microstructure of the base metal and weld deposit.

Hardness readings and microstructure examinations on a single bead weld made under severe cooling conditions, indicates that the weld-hardening tendencies of low carbon—½% Molybdenum Steel is only slight.

The above conclusion was also confirmed by heat-treating small laboratory specimens, it being necessary to water quench these specimens from 1925°F. in order to produce severe hardening. Air cooling from as high as 1925°F. and water quenching from as high as 1650°F. failed to produce excessive hardening.

The effect of preheating and stress relieving is readily noticeable on the elongation before failure in free bending. These variables, however, have little if any, noticeable effect on tensile test results.

Both hardness tests and microscopic examination from a multiple pass weld on a 6⅝" O.D. x .432" wall pipe which was neither preheated nor stress relieved indicate a structure with a similarity to the air cooled heat-treated specimens previously mentioned.

*Pittsburgh Piping & Equipment Co.

Proper joint designs for pressure piping require a root opening and ring design such that proper fusion is obtained in the root of the weld in addition to the fact that the included angle of the welding groove should be sufficient to avoid excessive undercutting and thus avoid the possibility of trapping slag along the side walls of the weld.

Deep etch tests taken from various positions from operators appearance welds as well as physical tests removed from heavy wall pipe in the preheated and stress relieved condition indicate electric arc welding to be a superior method of jointing carbon-molybdenum piping for high temperature high pressure service.

» «

Measurement of Contact Resistance

By W. B. KOUWENHOVEN* and J. TAMPICO*

★Of all the factors entering into the resistance welding process the role played by the contact resistance between the welded parts is probably least understood. The authors are engaged in an experimental investigation of this factor.

After careful study, a solid cylindrical specimen 0.5 inches in diameter and 2.5 inches in length was developed. Its use eliminated many variables from the problem. Very fine holes, only 24 thousandths of an inch in diameter were drilled through the specimens. These holes were lined with glass tubing through which a fine wire could be inserted. When the specimens were mounted in the electrode holders of the testing machine, the wires were passed through the tubes and flash welded to the contact faces of the opposing specimens. These wires or probes thus gave direct connection to the actual contact surfaces. They served as connecting leads for the resistance measurements. The contact resistance was also measured by means of needle electrodes held against the sides of the specimens.

A special Kelvin Bridge was developed and built for measuring the contact resistances. This bridge was sensitive to changes in resistance of less than one-hundred millionth of an ohm. The results as obtained by the two methods of measurement were in general in excellent agreement. In no instance was the contact resistance found to vanish. Provision was also made for determining the temperature gradients along the axes of the specimens by the insertion of very small insulated thermocouples. The temperature at the contact itself was obtained from a plot of the temperature gradients.

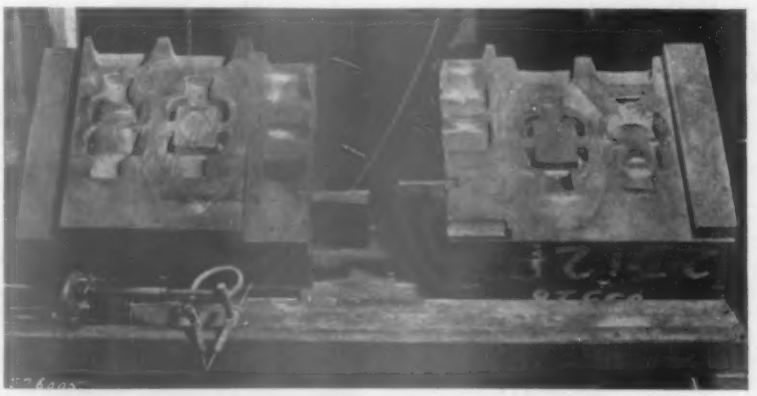
The specimen surfaces of any given material studied were given identical treatments. Their contact resistances differed when tested under the same conditions of pressure and current but the ratio of the highest to the lowest values obtained was only three to one. Measurements of the contact resistance are reported for cylindrical specimens of 25 point carbon cold rolled steel and commercial aluminum at constant current with variable pressure and at constant pressure with variable current. Pressures up to 40,500 psi and currents up to 600 amperes, (3,000 amperes per square inch of contact surface) were used in the investigation. Temperatures at the contacts of 500°C were noted.

The constant current-variable pressure test results gave nearly straight lines when the data on contact resistance versus pressure were plotted on log-log paper. Due to the type of specimen and their definite area of contact, the decrease in contact resistance with pressure was not as marked as that reported for sheet materials. The contact resistance was found to decrease with increasing current at constant pressure. The drop was quite rapid at the higher values of current. The results of the temperature measurements clearly show that the contact resistance has a large influence upon the temperature attained at the contacts. In specimens, having a contact resistance of one or more millionths of an ohm, the effect of the contact resistance on the temperature was definite. If on the other hand the contact resistance was of a very low value, the location of the point of highest temperature in the specimens was not at the contact itself but some distance above it.

The conclusions reached were:

1. A method has been developed for the accurate determination of contact resistance.

*John Hopkins University.



Worn dies are rebuilt readily using Atomic Hydrogen equipment. (Photo General Electric Co.)

The cutting torch is an indispensable tool in welded plate fabrication.

2. The contact resistance decreases with increasing pressure, the decrease being most rapid with the initial application of pressure.
3. Increasing temperatures cause the contact resistance to fall more rapidly with initial pressures and to decrease at constant pressure.
4. The temperature reached by a contact carrying current depends on the magnitude of the contact resistance. Higher contact resistance lead to higher temperatures.
5. The temperature reached by a contact under pressure depends on both the current density and the pressure. Increasing currents lead to increasing temperatures. Increasing pressures lead to decreasing temperatures.

» «

Fundamentals of Resistance Welding

By RALPH S. PELTON*

★ It was the aim of this paper to review the fundamentals of the resistance welding process for the beginners and to discuss some details for the more advanced students. Since the subject was so large, the author gave 8 references to papers which he thought covered certain phases of the subject well and confines his detailed discussion to other phases which he had not seen discussed so thoroughly.

The importance of producing only good welds was stressed and many of the factors which influence the quality of the welds are discussed. The problem of pressure was treated in some detail with the effects of the magnetic field and inertia in particular. Assembly operations and location of the weld were discussed with emphasis on the importance of having the soft metal entirely surrounded by solid metal during the making of the weld.

The importance of the condition of the surfaces to be welded was emphasized with a narrative of personal experiences leading to the conclusion that not all that glitters is gold. All discussion were directed toward the conclusion that if all the factors entering into the making of welds are properly controlled, uniformly good welds can be made indefinitely.

*General Electric Co.

Welding Electrical Equipment

By R. A. TAYLOR*

★ This paper about welding electrical equipment illustrated how the technique of electric arc welding has provided a flexible medium for manufacturing electrical machines.

Briefly, using the electric arc welding process to manufacture machines presumes a general working knowledge of the welding process itself in addition to a comprehension of the auxiliary equipment necessities, design requisites, material selection, and adequate manufacturing methods. An understanding of each of these five essentials balanced in their proper relationship, one to another, is the pre-requisite to successful economic machinery fabrication.

Welded fabrication requires that the manufacturer have in suitable quantities and sizes, dependent upon the production requirements and magnitude of equipment manufactured, handling equipment —cranes, hoists, and manipulators; preforming machinery — shears, presses, press brakes, punches, cutting machines, and rolls; welding equipment — welding machines and accessories. Designs must be made based on a knowledge of available fabricating equipment, weld stresses in fundamental design, load requirements, and accessibility of the welds to the welding operator. It is desirable to select fabricating steel which has good welding characteristics, is ductile and lends itself to pre-forming and which falls within the standard sizes furnished by steel fabricators for economic purchase. Sufficient regard must be given the welding process itself, auxiliary equipment, design and selection of materials to the requirements of each of these essentials. However, without adequate manufacturing methods used to employ the first mentioned essentials no satisfactory or economic machines may be successfully built.

Manufacturing techniques carefully established in the form of fabrication specifications provide an essential descriptive aid showing operation sequence related to respective required manufacturing equipment. All are necessary for fabricating electrical machines. Electric arc welding of electrical equipment can be and is a flexible economic manufacturing process lending itself to modern fabrication.

*Transportation and Generator Works Department, Westinghouse Elec. & Mfg. Co.

» «

Design of Heavy Rolling Mill Machinery

BY GEORGE W. LINKHAUER*

★ In this paper was expressed the viewpoint of the Engineering Department concerning training of department's personnel in the use of weld symbols and the method of design to attain utility, appearance, and economy.

Draftsmen, whose previous experience in fabricating plates and rolled shapes often was with riveted construction only, are trained to understand the added simplicity of welded structures, sometimes eliminating the use of angle plates, and in the ready application of stiffeners and gussets. Several sketches of the common methods and revised methods are shown the draftsman, depicting the elimination of unnecessary or objectionable parts by substituting simpler design and at the same time expediting machine finishing in the shops.

It has been found advantageous to have certain standard parts made of cast steel and useful for a variety of our machinery, such as bolt lugs, lifting lugs, and a standardized clamp plate for inspection holes; each made in several sizes.

A systematic thoroughness in the application of welding symbols to drawings in order to attain full value and

*United Engineering and Foundry Co.

Size makes little difference in the construction of welded pressure vessels.

safety of the structure is encouraged, and to definitely instruct the weld shop in the amount and location of deposited metal expected.

The Engineering Department should work in collaboration with the machine shops to encourage the use of jigs on welded structures, often doing some major machining operations before completing the welding and still maintaining exceptional accuracy.

The presentation included a number of photographic slides showing machinery in process of fabrication in the welding shop.

» «

Shape Changes in Spherical Spot-Welding Elctrodes

By W. F. HESS[1] and R. A. WYANT[2]

★This paper is a report on preliminary studies of the use of spherical spot-welding electrodes. A method of following changes in the shape of electrode tips during the making of a series of welds is described. This method consists of taking lead impressions of the tips in lead discs and then measuring the profiles of the impressions by means of a profilometer. Six series of 1000 or more welds were made using tip radii of 4 inches and 1½ inches. Three different pressures were investigated. Profiles and hardness surveys at the end of several typical series of welds are shown. Photographs of etched weld sections show examples of "ring" type welds produced in welding oily steel. This formation of weld is ascribed to the black deposit which built up on the tips after a number of welds had been made in oily steel. Normal welds were produced throughout all series in which the steel was degreased and the tips kept clean and bright.

Data obtained from the six series of welds is summarized in useful tabular and graphical forms. As a result of the work the following conclusions are drawn:

1. Flat areas begin to form on dome-shaped electrodes as soon as welding is commenced. After about 200 welds the diameters of these flat areas increase slowly with the number of welds made. The possibility exists that under the proper conditions this diameter may reach a limit and remain constant for subsequent welding.

2. Degreasing of stock is recommended, if sound welds are to be expected over long periods of welding. The black deposit that forms on the electrodes in welding oily stock definitely impairs the quality of the welds produced. This deposit, having a high electrical resistance, forces the current to pass around it, thus forming ring type welds. The same effect should be expected in making a large number of welds with flat tips under comparable conditions.

3. Higher pressure densities can be used with dome tips than with flat tips without producing extrusion between the sheets.

4. When expulsion of molten metal occurs in welding with dome tips, large cavities are left, regardless of the pressure.

5. A very extensive program of research involving the use of dome-shaped tips will have to be undertaken before a complete picture of their behavior and proper use will be known. This is because of the number of variables involved, and the time-consuming nature of each step. Insofar as possible the scope of such a program should be circumscribed by appropriate flat tip studies. This is justifiable from the fact that domed surfaces always develop flat contact areas.

[1]Associate Professor of Metallurgical Engineering, Head of Welding Laboratory, Rensselaer Polytechnic Institute, Troy, New York.

[2]Research Fellow, Department of Metallurgical Engineering, Rensselaer Polytechnic Institute, Troy, New York.

Proper cleaning and finishing is essential in welded construction.

» «

Resistance Flash Welding of Strip Steel

Resistance Flash Welding of Strip Steel

BY J. H. COOPER*

★ The demands by the customers of the steel industry for larger coils of strip than can be rolled on existing hot mill equipment, and the need of larger coils for more efficient processing of the strip in steel mills have made welding of multiple coils a necessity. The resistance flash welding process meets the requirements of high production, best of weld quality and low maintenance cost of machinery with no increase of unit labor cost due to the requirements of a higher degree of manual skill required in other processes. By this process, using no filler metal or adjustable arcs or flames, welds are made with heated areas and sheet warpage only a fraction as great as are obtained with other processes. Quality is such that welds and welded strip are often cold-reduced to 10 to 20% of their original thickness. Welding speeds surpass speeds obtainable by any other method. For example a ¼ in. x 90 in. strip can be joined in 25 to 30 seconds.

Consistent quality of product is insured by such a process which takes the actual flashing of the welding from the operator and places it as a function of equipment which will give a high degree of uniform quality.

An analysis of this process as to requirements to be met at the weld itself are indicated as follows:—

(1) A proper start of the flashing action.

(2) The "flashing-off" or burning away of a sufficient amount of metal for the particular gauge of strip under consideration at an optimum rate and optimum welding voltage and current.

(3) A speedy and powerful "Upset" or forging action of proper magnitude.

Weld characteristics are such that with an extremely narrow heat affected zone, the following test values are typical in .06% carbon A1, deep-drawing steel:

(1) Hardness—Maximum weld hardness averages 10 to 15 points Rockwell B over hardness of parent metal of approximately 65 points Rockwell B Scale.

(2) Tensile tests — Tensile tests made on coupons cut transverse to the line of weld always break well outside the weld or heat affected area.

(3) Ductility — Olsen tests indicate that 610 for unwelded strip **vs** 552 for welded strip using a ⅞-in. diameter ball and 1½-in. die are typical readings.

(4) Metallurgical inspection reveals typical heat affected areas, of course, minus any zone of deposited metal and all within a very restricted width of affected area. The scavenging action of the arc and the squeezing out of fluid metal during the forging action essentially eliminates any slag or oxide inclusions.

Electrical power requirements are quite low, relatively speaking and are approximately 25 Kva per square inch of welded cross section during the flash-

*Welding Engineer, Taylor Winfield Corporation.

ing operation. This figure of 25 Kva is about one-fourth of the equipment nameplate rating per square inch of welded maximum section. The nameplate rating is merely indicative of a means of standardizing equipment and has no direct connection with the power demand during weld.

In conclusion it may be said that resistance flash welding of steel strip is becoming more and more a necessity as competitive pressure in steel production increases.

» «

Spot Welding in Aircraft Construction

By CHARLES F. MARSCHNER*

★This paper set forth the general requirements for spot welding equipment suitable for welding aluminum alloy assemblies for the aircraft industry, presenting the reason for some of these requirements, describing the advantages accruing from the use of spot welding from design standpoints and suggested the formation of a group of welding authorities to cooperate with the aircraft industry and the Army and Navy to further the application of spot welding in aircraft.

The paper was limited to cover only the equipment requirements for aircraft production and the factors affecting design. Lack of standardization of welding by an authoritative source and the development expenditure required to enable the manufacturer to successfully use the equipment provided are considered to be the reasons why spot welding has not previously enjoyed extensive usage in the aircraft industry.

The ability to consistently produce high quality, uniform welds is the primary equipment requirement. Equipment flexibility, both mechanical and electrical, was emphasized and reasons given for the requirement of flexibility. A battery of machines, each flexible throughout a given electrical and mechanical range was suggested for quantity production. Definite requirements for operating range and mechanical features were set forth. The advantages of the conventional A. C. and the newer "stored energy" type of welder were compared. The application of seam welding and the need for portable spot welding equipment for aluminum alloys were discussed briefly.

In designing for spot welding standard welder settings must be fixed in order that uniform strength can be depended upon for structural analysis. A chart showing typical desirable weld strength as compared with rivets was shown. The cost ratio between rivets and welds were given as approximately 10 to 1. Normal welding speed was given as 5800 welds per eight hour shift. Comparisons of riveting and welding were made for a typical spot welded airplane. The comparison covered weld-rivet ratios for several major airplane components and weight saved. The net cost ratio between rivets and welds is 5 to 1. Aside from the advantage of reduced cost the advantages of spot welding over riveting are (1) flush surfaces, (2) reduced weight, (3) more rapid clearing of assembly jigs and (4) enforced breakdown of parts into efficiently handled subassemblies. Data were given for rolling pressures to be used in cold working spot welds where high stresses are imposed on skin-stiffener combinations in compression.

It was suggested that a group from the American Welding Society be appointed to cooperate with the aircraft industry in development and standardization of welding. Suggested projects included (1) development of more suitable methods of calibrating and rate welders, (2) development of welding standards for the welding variables based on calibrated output, time, pressure etc., (3) standardization of allowable design strength for welds based on standard settings for the welding variables and (4) development of methods of weld inspection and standards for checking operators on the quality of welding done.

*McDonnell Aircraft Corporation.

» «

Cast Iron Welding Electrodes

By GILBERT S. SCHALLER*

★To produce a weld in cast iron having as nearly as possible the same characteristics as the casting it is desirable to use cast iron electrodes, realizing that it is impossible to strengthen the broken part by welding beyond the strength for which it may have been designed. To produce a cast iron electrode that yielded welds without hard zones and cracks was the object of the present research. In order to improve cast iron electrodes, they were coated with materials designed to overcome the deficiencies of bare cast iron electrodes. The coatings were applied by dipping. The performance of the electrode during d.c. welding depended on the coating.

Over a hundred coatings were studied, ranging from simple mixtures of graphite and waterglass to complex six-component mixtures. The electrodes were used to butt weld preheated cast iron plates ½ in. thick. Every weld was examined for fusion and penetration. Coatings that evolved considerable gas produced porous weld metal. Indeed, porosity was more difficult to avoid than coarse graphite structure. All welds were machined to detect zones, if any, that were difficult to machine.

Of the coatings that were tested, several gave satisfactory results. For example, sound welds were secured with a coating containing 15% graphite, 15% sodium carbonate, 6% titanium, and 64% sodium silicate. Another satisfactory coating contained 13.1% graphite, 0.4% titanium oxide, 6.6% cellulose, 2.7% calcium carbonate, 4% ferrosilicon, and 73.2% sodium silicate. When welding was performed at 200 amp gas and slag inclusions were less troublesome than at 125 amp. If there was excessive carbonaceous matter in the coating a film of carbon formed on the V at low currents which prevented smooth flow of metal and good root fusion and penetration. The average Rockwell hardness was 89 B for base metal, 95 B for fusion zone, and 100 B for weld metal. The major results of the investigation show that satisfactory arc welds can be made in gray cast iron with cast iron electrodes, if the core rod contains suitable alloying elements, and if the coating is suitably compounded.

*University of Washington.

» «

Friction and Inertia in Resistance Welding Machines

By W. F. HESS[1] and R. A. WYANT[2]

★Recently there has been increasing recognition by manufacturers and users of resistance welding machines of the importance of friction and inertia in the performance of such machines. This recognition has been based on the logical intepretation of a variety of industrial experiences. It became evident that a method of making dynamic pressure records during welding would have an important place in any careful investigation of these phenomena. It was the chief purpose of the early work described in this paper to develop such a tool, for use in research. The development of an electric pressure gage is described in the paper, together with methods for evaluating the actual magnitudes of the friction and inertia.

The paper also presented the results of a variety of dynamic pressure studies, including different types of welding machines, and cases illustrating the effects of large and small amounts of friction and inertia. The work showed that there is no serious loss of pressure during the welding of mild steel, unless expulsion of metal is allowed to occur, even when there is considerable friction and inertia in the machine. Elastic deflection of parts of the welding machine, such as electrode arms, were found to render ineffective and harmless, both friction and inertia. Factors affecting the magnitude of friction and the relation between starting friction and sliding friction are discussed. Care in the selection of lubricants and in the maintenance of proper lubrication are stressed.

[1]Associate Professor in Metallurgical Engineering, Head of Welding Laboratory, Rensselaer Polytechnic Institute, Troy, N. Y.
[2]Research Fellow, Department of Metallurgical Engineering, Rensselaer Polytechnic Institute, Troy, N. Y.

Now Is the Time to Join the

AMERICAN WELDING SOCIETY

•

33 West 39th St. New York City

Production Flame Hardening of Machine Parts

By J. ERLER* and P. H. THOMLINSON*
*Farrel-Birmingham Co.

*The application of the art of flame hardening to machine parts is comparatively recent. This probably accounts for the small amount of published information about the physical properties of a flame hardened part, but it is known that proper design has an important bearing upon the success of the application.

The mechanics of the process, and the analyses of suitable materials have been quite thoroughly covered in previous papers.

The material to be hardened must be very carefully selected and controlled.

Physical requirements, fabrication limitations and economic factors influence the selection of material for a flame hardened part. Forgings, rolled plate, steel castings and certain grades of iron castings are normally used.

The analysis is particularly important, as the process, while somewhat flexible, is not adaptable to as many variations in technique as are the full hardening methods. Previous heat treatments, if any, as well as the chemical analysis should be made known to the flame hardening operator before work is started. Cold straightening immediately prior to flame treatment should be avoided unless stresses are relieved by additional treatment; otherwise the part is almost sure to distort considerably during hardening.

Close inspection must be made of forgings and rolled plate for seams and laminations as these defects on a surface being flame hardened will open up very noticeably.

When castings are planned for flame hardening, the foundry should be instructed to take particular care with the surfaces to be treated as slight shrinkage, blow holes or dirt are very detrimental.

Too much emphasis cannot be placed upon the necessity for carefully standardized and controlled procedures for flame hardening. The behavior of certain metals under a specific group of conditions can best be determined by running sample test specimens which may then be broken, the results noted and plotted on a graph to be used as a standard upon which future work with that material is based.

Equally important is the selection of operators. They must not only be able to efficiently perform the flame hardening operations, but must be sufficiently versed in the behavior of metals under heat to appreciate the necessity for strict adherence to standardized procedures. Young men with two or three years experience in a metallurgical laboratory have met these qualifications.

Distortion during flame hardening, while usually less than in full hardening, does occur in some parts but in many instances can be anticipated and minimized by following a few simple precautions, such as externally cooling with water, machining allowances or bending before hardening in the opposite direction to the curve of distortion.

Flame hardening, as any other process, has certain limitations that are learned through experience. For instance, many small parts may be completely hardened at a lower cost than selective hardening; caution must be observed when attempting to harden very thin sections or surfaces involving very abrupt section changes.

There are, however, many advantages to the process such as, (1) The ability to harden the wearing surfaces of a piece that is too large to be economically hardened by any other known method. (2) Selective hardening of required working surfaces only, of intricate parts so designed that almost any other method of treating would be a failure due to warpage or cracks. (3) Ability to produce a deep, hard, non-crushing case while still retaining the desirable properties of a soft, ductile core. (4) Freedom from heavy scale and in many instances, lack of distortion.

A few of the many machine parts to which flame hardening has been successfully applied are gears, mixing chambers and discharge doors of a rubber mixer, various rings for numerous purposes, rolls and shafts, adjusting screws, centers, jigs and fixtures for machine tools, wabbler sections of spindles and couplings, roller bearing journal boxes, dies and cams.

Despite the fact that the process has only recently gained prominence its numerous advantages are already recognized. As the possibilities of this art are more thoroughly investigated its uses will multiply and the life of many more machine parts will be materially increased.

» «

Welding of Passenger Cars

By A. M. UNGER*
*Development Engineer,
Pullman-Standard Car Mfg. Co.

★The girder type of passenger car is built with flat sides. The smooth sides with no projections give a very pleasing appearance and are easy to clean.

Many problems had to be solved to produce the smooth side. In the old days of riveted cars, buckles in the side sheets were not as objectionable because the rows of rivet heads drew the attention of the eye. These evenly spaced rivets in straight rows gave an explanation for dips and bulges in the side sheets. When spot-welds replaced the rivets in the car side, there were no projecting rivet heads to hide the buckles. It therefore became necessary to make a better side with spot-welding than had been made with riveting.

The first experimental panels that were spotwelded showed that considerable trouble with buckling would be experienced. Spotwelding of a car side consists of vertical rows of welds on the side posts and horizontal rows of welds on longitudinal framing members at the top and bottom of the side and at the top and bottom of the windows. This means that the car side is divided into panels having spotwelds completely around their perimeter. The panels are formed above and below the windows and in between windows.

Each spotweld shrinks a certain amount. The reason for this shrinkage can be shown by considering what happens when a spotweld is made. The volume of metal included between the two welding electrodes is heated to a high temperature, in some cases even to a melting temperature. Metal expands with heat; therefore the heated metal between the spotwelding electrodes tends to increase in volume. It is restricted in its expansion by the cold metal surrounding the heated area. The expansion force is very great and results in upsetting of the metal around the outer edge of the weld. On cooling of the weld, the upset metal cannot return to its original position and the dimension of the weld reduces slightly. While this value may be small for each individual weld, the total for a series of welds can easily be measured.

As a result of this shrinkage, a panel that is surrounded by a row of spotwelds has its outer perimeter shortened. The natural result of this is to throw a bulge in the panel.

To actually check this shrinkage on a panel, a section of a car side was spotwelded. It consisted of a 10-foot length below the window openings. Spotwelds were spaced one inch apart. There were four vertical posts. The panel between the posts was divided by a stiffener. This formed six panels. Measurements to determine the overall shrinkage were taken. After these measurements were made, the spotwelds were peened and the overall length again measured. The results of these measurements show an overall shrinkage due to the spotwelding, and an overall expansion due to the peening.

Buckles in the panels were measured with a straight edge. These measurements were plotted. The curves gave a good idea of the variation in buckles due to the welding and peening. In some panels a decided improvement was seen due to the peening. Even peening of adjacent panels had considerable effect.

Peening to eliminate buckles was actually tried in production. It soon became apparent that, while the buckles could be eliminated, the best results would be obtained if the buckles were prevented from forming in the first place.

To prevent the shrinkage of the spotwelds that join the side sheet to the framing from causing buckles, it was decided to stiffen the side sheet by the addition of a very light gauge, corrugated stiffener spotwelded to the outside sheet. This stiffener would have strength enough to resist the stresses set up in the sheets by the shrinkage of the spotwelds.

The stiffener worked out very well in production, eliminating any straightening, and produced the smooth side desired.

Operation Problems in the Small Welding Shop

BY R. B. WHITE* AND J. T. LEWIS, JR.*

*Lewis Welding and Engineering Corp.

★In considering the problems of the small shop it is reasonable to assume that we are discussing the large group of little businesses that employ from one to fifty or more men, and whose work covers every conceivable application of welding and cutting from the country blacksmith shop that repairs farm implements to the highly specialized organization that builds Class I pressure vessels.

Classification—Small shops

A welding shop, as such, may fall into one of two categories; it may be an operating department of a larger organization, essentially selling its entire output to the parent company, and having all its functions directly supervised by the parent company, or it may be what is generally termed a "jobbing shop". If the latter, its operations may be set up in one or more of the following patterns:

(1) A business which is organized to furnish an engineering and design service as well as fabricating facilities, and which essentially functions as the welding department for a limited group of customers, but on a contract basis and under its own supervision.

(2) A business which bids on general work of almost any description and which depends largely on the customers' engineering and design.

(3) The sheet metal shop.

(4) The shop which specializes in repair and maintenance.

(5) The shop which is organized and equipped to do field erection and construction, such as pipe lines, stacks, tanks, and steel buildings.

Time does not permit a complete examination of all the problems of all these classifications. It is the purpose of this paper to discuss a few salient problems which will probably be common to all welding and cutting shops, although the background of the argument is, based on experience gained in both the welding department of a large company and in a small shop which specializes in the construction of machinery parts for a limited number of customers. We wish merely to point out a few problems which continually arise and suggest at least one method of meeting each of them. For clarity we have separated the discussion of welding from the discussion of cutting, although practically every shop performs both operations.

Design Problems

One of the foremost problems of the welding shop is the procuring (or executing) of adequate drawings and details of the parts to be made. In this connection, it is probably a safe rule to arbitrarily assume that the customers drawings are wrong until proved otherwise. Wherever possible the organization that is going to execute the work should make every effort to have the plans and specifications adjusted to make the most economical use of the shop equipment. A heavy bending brake may eliminate a great deal of welding and the type of welding equipment may dictate the welding procedure. If steel castings are included as part of the welded assembly, take time to make sure that they are essential. Frequently if a hydraulic press or a bulldozer is available, by use of simple and inexpensive dies, relatively complex shapes can be produced at a lower cost than patterns, core boxes, and castings. As a general consideration, use plates wherever possible, rolled shapes where desirable, and castings only when special analysis or proved economy leaves no other alternative.

The principal problems insofar as shop operation and supervision are concerned can be grouped as follows:

(1) Welding
- (a) Personnel — training, qualifications, etc.
- (b) Use of special equipment.
- (c) Assembly jigs and fixtures.
- (d) Special welding procedures.
  - (I) Preheat.
  - (II) Stress relief.
- (e) Appearance of finished product.
- (f) Special requirements.
  - (I) Oil tight welds.
  - (II) Machinability.
  - (III) Rigidity under load, etc.

(2) Cutting
- (a) Production cutting on automatic machines.
- (b) Shear versus torch cutting.
- (c) Templates and hand tracing.
- (d) Care of equipment.
- (e) Regulation of speed, pressures, etc.
- (f) Stack cutting.
- (g) Scarfing.
- (h) Special care with alloys and higher carbon steels.

In conclusion, it is to be emphasized that welding is a field for skilled mechanics. A good welder cannot learn his trade in 30 days in a welding school, nor can he learn it in 30 weeks. Thirty months should make a reliable operator if he has good supervision and assistance.

The art of fabrication by welding far transcends the melting of welding rods by arc or acetylene flame. While we cannot expect all welding operators to be metallurgists, they should understand, in general, what happens when the weld metal is deposited; how the various types of rods perform under various conditions; what constitutes good workmanship. They should be capable of correcting disadvantageous conditions without complaining of "poor ground," "bad fit-up," or "wrong kind of rod."

Probably the most useful men are mechanics who can weld. By rotating work the small shop organization becomes more flexible and develops men of broader experience who can fill in where they are needed most. If the press operators can weld and the assembly mechanics can also run the burning machines and do layout work for example, changing schedules do not require frequent personnel adjustment and long hours for some men and short hours for others — a condition which always breeds discontent.

Someone has defined skill as the ability to do the best job in the quickest and cheapest way and our experience gives us no indication but that this rule applies in the welding shop the same as anywhere else.

» «

The Effect of the Physical State of Steel Upon the Tensile Strength of Brazed Joints

BY F. C. KELLEY*

*Rearch Laboratory, General Electric Company, Schenectady, N. Y.

★It was the purpose of the author to show that when electric furnace brazing is carried out under ideal conditions, the tensile strength, yield point, and proportional limit of a brazed specimen are approximately the same as those obtained with an unbrazed specimen of the same material simiarly treated.

The variation of the heat treatment of the brazed steels selected; namely, cold drawn Bessemer, 0.35% carbon, drill rod, and 3½% nickel — 0.35% carbon, produces a marked effect upon their physical characteristics, as is the case with unbrazed specimens with identical heat treatment.

It was found that carbon steels are not easily wet by copper in a pure dry hydrogen atmosphere of sufficient purity to reduce chromic oxide. Even after decarburization, the same was found true, for the carbon diffused back to the surface before the copper melted.

It was also found that when the last three steels mentioned previously were decarburized and brazed, with the copper assembled in the joint, the results were still not so good as might be expected, even when the atmosphere of hyrogen approached that used in commercial furnaces. The carbon diffused back to the surface and, since the joint was not open as is the case in commercial practice, the oxygen and moisture could not diffuse in as rapidly and keep the surface free from carbon so that the copper could wet it.

These same carbon steels when decarburized, coated with a solution of nickel nitrate, and brazed in pure hydrogen, gave results which were better, much more uniform, and closely approached those of the unbrazed sample.

The evidence presented is sufficient to lead one to believe that if a perfect brazed joint could be made under the conditions described, the brazed sample would have the same properties as the unbrazed sample.

The variation in strength of the high copper-iron alloy of the joint with the heat treatment of the steel is explained by the very thin layer (0.0008") between two steel surfaces. The alloy is held very firmly by the steel on either side. It cannot neck down because it is too thin, and it cannot elongate for the same reason. Nothing happens to the copper joint until some movement takes place in the steel. For all practical purposes the brazed specimens behave exactly like the unbrazed ones.

★ ALLOYS

Figure 1—This part, for a milk can filling machine, is made of stainless steel sheet 0.015 in. thick.

Welding in

the Fabrication of

Thin Stainless Steel Sheet

★ Atomic Hydrogen welding process used primarily with occasional silver brazing. Seven steps in finishing operation.

IN THE PLANT of Metalsmiths, Orange, N. J., the fabrication of corrosion-resisting equipment is a specialty; and because the range of industries served by its products is rather wide, normal operations demand facilities for forming, welding and finishing of all commercial thicknesses of corrosion-resisting materials. The present discussion is concerned with various phases of fabricating the very thin sections of chrome-nickel alloy steel.

Both of the pieces illustrated are parts of milk plant equipment. Fig. 1 is a close-up of one of the stainless steel shells that are inserted in the discharge mechanism of can filling machinery to prevent excessive foaming. It is about 4 in. in diameter by 8 in. high. Prime requirements in this piece are high polish and absolute freedom from crevices or pits on the surface. The material is stainless steel sheet, 0.015-in. thick. Although the weldability of the alloy has long been established, it is obvious that in the case of such thin sections the tendency toward buckling and the susceptibility to burning through the sheet, present welding problems that are serious.

Preparation of Work

Cost of the base material here is a considerably larger factor than in the case of ordinary mild steel. It is therefore necessary to take more elaborate precautions against spoilage, better preparation of the work than is usually necessary for such items as are usually made from thin sheet steel, more precise set-up and a carefully developed execution of the weld itself. In general, defects cannot be corrected by rewelding.

Fig. 2 is a sketch which illustrates the assembly and fabrication method on these shells. Part "A" is cut from flat sheet, rolled to a truncated cone shape and welded. The dotted line shows the shape as welded. Then a small flange is spun down on the base of the cone, to obtain a butt joint with part "B". The latter is a rolled cylindrical shell with its longitudinal seam butt welded, after which the bottom taper is spun. The final weld is the girth seam between the two sections.

Jig Construction

Great care is exercised in the design and construction of jigs which allow a uniform fit-up and effec-

(*Continued on page 42*)

Spot Welding vs. Die Casting

A new development in the battle between die-casting and assembly spot welding for complicated units is a process created for a leading automobile company for assembling its 1941 radiator grilles.

With this rather unique equipment which was designed and built by Progressive Welder Co., 3033 E. Outer Drive, Detroit, Michigan, some 1,000 stampings are being assembled with 4,000 spot welds into 100 complete radiator grille halves per hour.

Features of this equipment are:

1. Use of rubber tired movable jig-fixtures which are the lower electrodes during welding.
2. Multiple spot welding in series with 20 "guns" per station, each having two self-equalizing tips — 2 welds per gun. Equal pressure also to all welding guns through use of a hydraulic pressure booster welding unit.
3. Completely automatic machine operation including automatic locating of the movable jig and welding.
4. Hand clamping of work is entirely eliminated.
5. Entire sequence of operations — for loading parts into jig, and unloading for both radiator grille halves — requires but 5 by 12 feet of floor space.

Dual Welding Stations

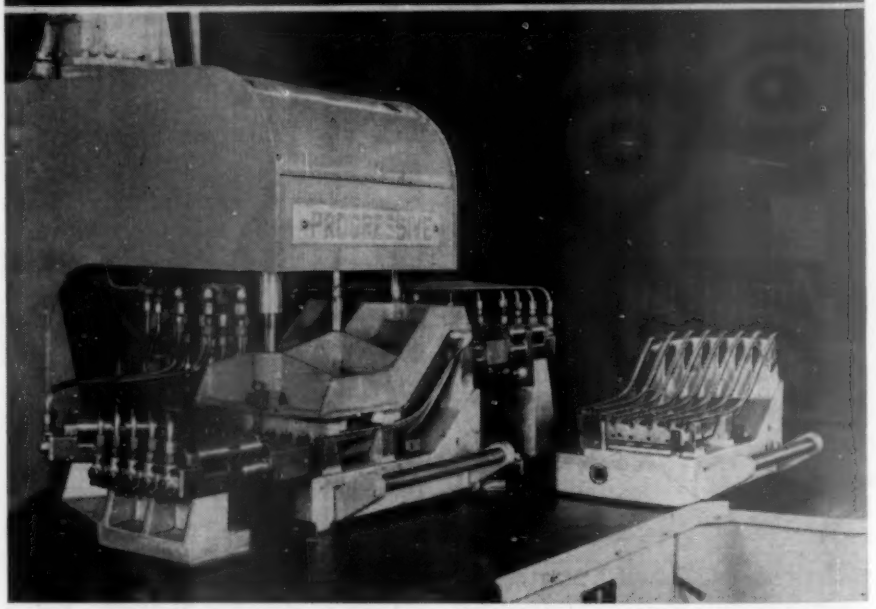
The machine has two dual welding stations and two jigs mounted on rubber tired wheels are used with each station. Each station is manned by two men. Each man handles one of the movable jigs which he loads, shoves into machine for welding, and pulls out for unloading. Thus while one operator is loading his jig the second operator is welding the parts on his jig, and vice versa.

In operation, a jig is loaded with the component parts of a grille half and is then moved into welding position. Guides and locking pins mounted on the table locate the fixture. When the wedges of the upper electrode descend they clamp the work held in the lower electrode securely in position. An air operated clamp, which is the same form as the grille, presses the work in place on the welding jig and clamps the latter firmly on the table. This compresses springs which support the wheels and permits locating pins ate either end of the jigs to engage locating holes.

Self-Equalized Guns

Due to the unusual design which makes it possible, two welding tips are mounted on each gun, in such a manner that they are entirely self-equalizing and thus assure uniformity with double welds with one gun. In rapid succession, welding current passes from the transformer in the base of machine through two tips of one gun, through the mobile jig and back through the two tips of a second gun to complete four spot welds at one time. Twenty spots in all are required for each grille half. When the welding cycle has been completed, the jig is automatically released for removal and unloading. The right grille half is welded at one station — the left is handled at the other. After an operator

(*Continued on page 42*)



(Upper)—Upwards of 4,000 spot welds to "assembly-weld" 1,000 stampings into one hundred 1941 model automobile radiator grille halves are made per hour. Unique jigs wtih rubber tired, spring mounted wheels facilitate rapid handling of parts in and out of welding position. Two welding stations with two men per station—each loading, welding and unloading work.

(Lower)—One automobile radiator grille half jig clamped in welding position. The alternate jig is shown with welded part ready for rapid removal.

★ MAINTENANCE

Figure 1—In the construction of each of these boilers there was deposited more than a half mile of arc welding beads. (Photo Hobart Brothers Co.)

Some

Helpful Hints on

Boiler Firebox Welding

★ Arc welding for most repairs but gas is best on flue sheet knuckle patches. Repair short cuts given as well as descriptions of repair tools.

By ARTHUR HAVENS

OF ALL THE welding on a locomotive, the firebox offers the ideal spot for the welder to display his skill and save money. Although the results in most shops are somewhat the same, each one has different ideas and methods of going about the task of firebox welding. The shop that I am referring to uses the electric arc method almost entirely, with the exception of the flue sheet knuckle patch. A weld made in this spot with the arc would no doubt be just as strong, but with the gas torch it is possible for experienced operators to make a smoother job around the superheater flue holes.

The first place that a locomotive flue sheet shows signs of failure is at the top flange where the flue sheet is riveted to the crown sheet, generally called the flue sheet knuckle. It is not uncommon for these knuckles to crack (horizontally) from 6 to 30 in. While it is a simple matter to chip out these cracks and weld them, as soon as the locomotive can be tied up long enough, this badly-checked section is removed and replaced with a patch which is really a new section of flue sheet. This makes a great saving for it is necessary to remove but a few rows of flues to make room for the operator who will have to work in the water space. It is an accepted practice to use two operators on this application, the man on the firebox side welding the vee's while the other man helps to heat and reinforce the welds. Figure 2 shows a typical flue sheet knuckle patch. Obviously a great deal of pains must be taken in the alignment of a patch of this type, for when the welding is completed the flue holes should be very nearly perfect. It is customary to leave the flue hole elongated (up and down) about $\frac{1}{16}$ in. This allows the patch to pull the flue hole into normal size when it contracts.

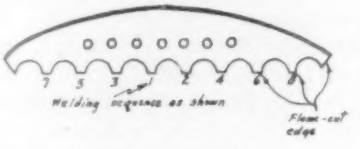


Figure 2—Flue sheet knuckle patch ready to apply.

Remove Scale

The thin coating of scale on the water side of the sheet should be removed in the area to be welded, for it is difficult to float this foreign

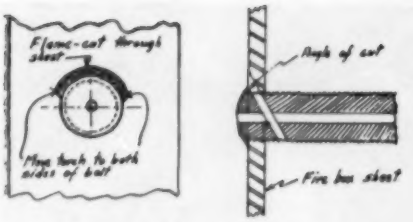


Figure 3—A method of cutting stay bolts.

matter to the surface of the puddle without making a "sloppy" looking reinforcement. As the weld progresses the fitting up bolts are loosened to relieve all strain from the weld. When the weld is cool the flange is laid up with a sledge and flatter. Due to the excess heat in the first row of crown bolts it is a good plan to remove them as they are generally loosened, this sometimes lets the crown sheet down on the flue sheet patch tight enough so that little or no fitting is necessary.

Side sheet patches are pretty much routine in all shops and engine houses and the same general procedure is carried out. However, here are a few short cuts that may be of some assistance. Although most boiler men are quite apt to disregard this fact, it is the opinion of most experienced welders that the side sheet patch not running to the foundation ring should be kept as near to a circle as possible.

Removal of Stay Bolts

By doing this the contraction stresses are more evenly distributed. Where the side sheet patch is to be used to mark off the new piece it is a decided asset to keep the staybolt holes in good condition. The simplest and quickest way to accomplish this is to cut the staybolt off by piercing the sheet at the top of the bolt, then holding the torch at an acute angle, moving it first to one side and then to the other side of the bolt, thus cutting it in two. After the patch or section of sheet is removed these pieces of bolt are easily removed with a blow from a hammer and chisel, thus leaving a good hole for layout.

The bolts left in the wrapper are removed in the following manner: A flame-cutting operator cuts the head from the bolt, then pierces the remainder of the belt at the "tell-tale" hole. This makes the piece of staybolt red hot. Next the cutter signals to his helper who slips a piece of pipe large enough to go over the bolt onto the stub end and pushes down on it. This strips the bolt from the sheet but does not injure the threads. When there are any great number of these stubs to take out it is a good plan to skip around, so that the heat transfer will not be too great in any one spot.

With the installation of large patches, or half side sheets, there comes the difficult and often aggravating task of removing the mud ring rivets. Numerous methods have been tried, but the following has been accepted as the best. The "driver" pictured in the accompanying sketch seems to work exceptionally well. It is used in a large riveting hammer and uses an ordinary three-quarter chisel blank

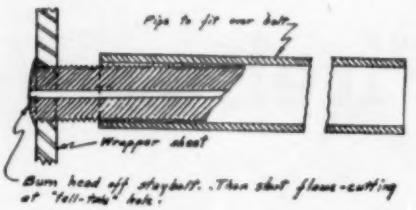


Figure 4—This staybolt may be removed without damage to the wrapper sheet threads.

for a pin. Again, the cutting torch comes into play on those rivets that need extra "persuasion." After the sheet or patch has been dropped out of the way the operator starts cutting on the outside of the rivet. While the operator is flame-cutting, the hammer operator occasionally tries to start the rivet; when it starts to move the cutting operator discontinues burning and steps out of the way of the hot piece as it is driven from the ring.

Emergency Repairs

It is a well established fact among railroad boiler men that a crack in a locomotive side sheet should not be welded, but as a superintendent of motive power once said, "It is no job to run locomotives and fix them the proper way, but it takes a good man to run them and not repair them the proper way." With this thought in mind, I will describe the method to be used, if such emergency arises. The crack should be scarfed with the cutting torch, as chipping may tend to increase its length. After carefully removing all slag and oxide, the operator should start welding about four inches down from the top and weld up to the top. Then start at the bottom and weld up about the same distance taking plenty of time and keeping the sheet as cool as possible. Then go back to the top and then to the bottom until the crack is completely welded.

For many years we were under the impression that we had perfected the welding of flue beads to the flue sheet. However, after experimenting with heavy-coated rod, we found that we could almost double the number of flue beads welded per hour. Welding flues with coated rod differs quite radically from the old-fashioned bare rod method. We find it best to weld down one side of a number of flues in one row then skipping a couple of rows and repeating the operation. When the initial row is sufficiently cool, the flux is removed from the top and bottom of each welded flue and the other side welded. Coated rod does not work well on a dirty sheet, the applied metal will be full of blow holes and chances are the weld will crack. Most welders prefer water in the boiler when welding flues, warm water when it is possible to obtain it. This speeds up the operation and keeps a great deal of heat out of the sheet.

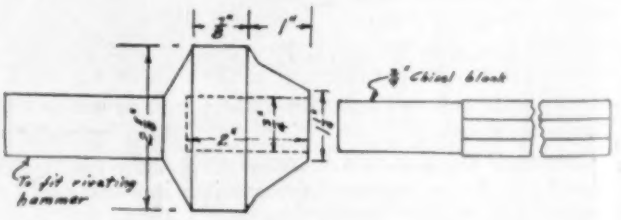


Figure 5—Backing out punch for removing mud ring rivets.

Brief Sketches of Welding Jobs

Figure 1—12,000 Gallon nickel clad tank for phenol storage. (Photo Wilson Welder & Metals Co., Inc.)

Corrosion Checked By Nickel Linings

★ The good welding qualities of modern nickel-clad steels enable the fabricator of chemical equipment to develop the most complex and intricate designs with full confidence that there will be no hitch in production. Illustrated here are a few of the special processing devices recently completed by Liberty Coppersmithing Co., Philadelphia, Pa., wherein a smooth nickel lining serves to make the equipment impervious to corrosive attack.

Figure 2—A complex processing tank. (Photo Wilson Welder & Metals Co., Inc.)

Figure 1 is a 12,000-gallon tank made for storing phenol, with heating members welded to the outside. The tank is 10½ feet in diameter and 18½ feet long. The heads are ⅜ inch thick and the shell ⅞ inch thick. It is 10% nickel clad throughout, except the butt straps, which are pure nickel.

A more complex unit is the 500-gallon processing kettle shown in Figure 2, which is made of ⅞-inch 20% nickel clad steel—with a steel jacket and an internal coil of pure nickel. Another jacketed job, of entirely different shape is the melting tank in Figure 3, 12½ feet by 8 feet. The baffles which divide it carry steam for heating the contents, and these, as well as the outside jacket are tested for 70 pounds working pressure.

Figure 3—A melting tank. (Photo Wilson Welder & Metals Co., Inc.)

Figure 3—Nickel lined kettle. (Photo Wilson Welder & Metals Co., Inc.)

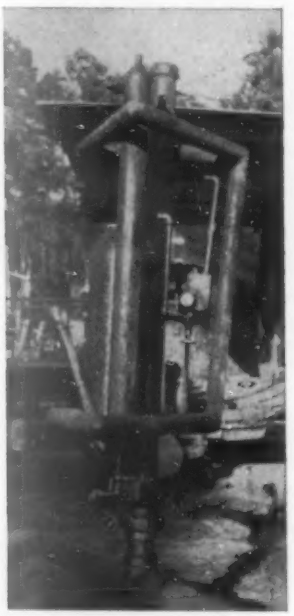
Figure 4 is a pure nickel lining, ⅞ inch thick, about to be placed in a cast-iron retort 4 feet in diameter by 4 feet deep, which had previously been lined with glass. One common characteristic of all these fabrications is that the nickel has been placed where it will be needed to resist chemical action. Another is that thoroughly developed fabricating techniques have enabled the designer to go far beyond the simple container shapes.

» «

Welded Frame Protects Lubricator

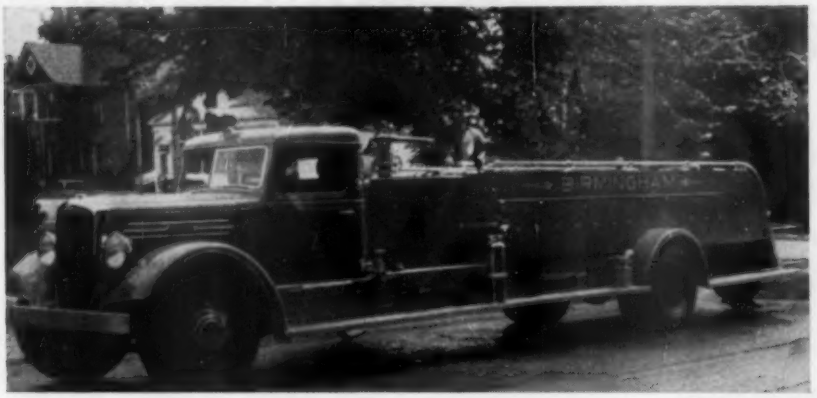
★ Hydrostatic lubricators, largely used around drilling rigs and other portable steam units, reach temperatures approximating closely those of the steam lines to which they are attached. Consequently bodily contact would result in serious burns.

By welding two triangles fabricated from two-inch pipe around the lubricator, one at top and the other at the bottom of the storage cylinder, a drilling contractor's welder succeeded in guarding the lubricator from accidental contact. Across one pair of angles of the triangles was welded a transverse piece of two-inch pipe which served to protect the sight-feed on the lubricator. It also offers a convenient point for attaching the truck's winch hook when moving or setting the unit.



Lubricator Guard

Due to the comparatively large area of the two-inch pipe guard and small area of contact where it is welded to the cylinder, the guard never becomes hot enough to cause burns. The lower triangle could serve as step for the fireman when replenishing the supply of oil in the lubricator.



The New Birmingham, Mich. fire truck is 34 ft. long, 6 ft. high and carries two booster pumps of 125 g.p.m. capacity.
Photo Lincoln Electric Co.

Michigan Fire Department Builds Own Fire Truck

*The Birmingham, Mich. fire department recently innovated a new means for keeping their firemen occupied while not engaged in fighting fires. They let the firemen build up the fire department! One way of doing it is to build a new fire truck and that is exactly what took place. Not only did the department build its own truck in its own fire house but it is estimated to have saved the taxpayers approximately $10,000 in doing the job. The department purchased a truck chassis fitted with a cab, to this was welded a number of steel shapes and plates which formed the body with its many lockers and accessories.

The finished truck is quite complete and includes, ladder racks, hose compartments, tanks and pressure mechanism, electric generating unit, pressure blower for masks, lockers and other accessories. It is estimated that the finished truck, which cost $4,800, would have cost $15,000 had it been purchased as a ready-build truck.

» «

Maintenance Welding Pays Steel Company

About seven years ago, a manganese steel shovel dipper used for handling hot slag on the dump of a large steel company became cracked. Due to the severity of the service, doubt was expressed as to whether the dipper could be successfully repaired. It was finally decided, however, to attempt to repair the break by welding.

A welded dipper repair.
(Photo Stulz-Sickles Co.)

Using a bare nickel-manganese steel electrode, the welding of the break was successfully accomplished. The welded repair was so successful the dipper gave over six years of continuous service before requiring further repairs. After this

Six years later the weld still holds.
(Photo Stulz-Sickles Co.)

long period of handling hot slag daily, the dipper again cracked and while it cracked in the vicinity of the original crack at no place did the crack go into or through the weld.

» «

Welding on Job Speeds Fabrication and Repairs

Welding a tool for fabrication as well as for a maintenance and repair is playing an important part in the building of Pennsylvania new toll road—the Pennsylvania Turnpike.

On the Baldwin Brothers Paving Company's contract welding is used both for fabrication and repair. As may be seen in Figure 1, welding is about the only means that could be employed in reinforcing a damaged corner on this all-welded carry-all type scraper.

Figure 1—Welding for Repair.
(Photo Lincoln Electric Co.)

Figure 2 is a tunnel discharge chute which was built in the shops of Guthrie, Marsch & Petersen, contractors on a tunnel near Berlin, Pa. A gate at each end of the chute controls the passage of

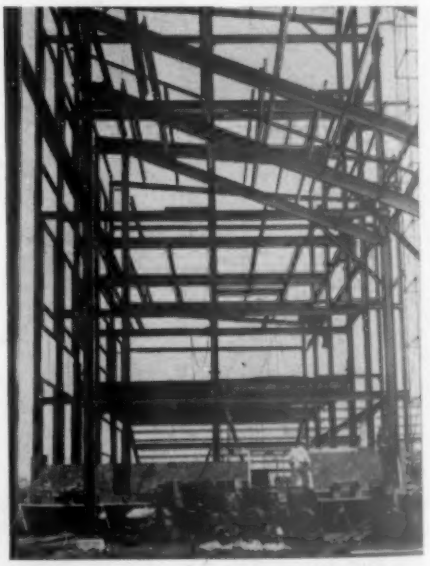
Figure 2—Welding for "on-the-job" fabrication. (Photo Lincoln Electric Co.)

concrete so that an uninterrupted flow of concrete can be maintained to the concrete boxes used in transporting concrete between the mixer and the tunnel.

» «

Arc Welding for Rapid Building Construction

*The Mathiesen Alkali Co., Niagara Falls, N. Y., have gone to welded construction on the structural steel work of five new buildings that are being erected to care for a plant expansion program.



One of five all-welded buildings under construction in Niagara Falls. (Photo Hobart Brothers Co.)

In order to erect the steel frame work using welding instead of the conventional permit welded construction is increas- riveted fastenings, it was necessary to ing every month.
change the city building code. The list of cities that are adapting new codes to

Frames for 15-ton erecting crane are fabricated with the aid of 500 amp. A-C arc welder. (Photo General Electric Co.)

A-C Welding Used in Fabricating Crane Frames

The Lewis Welding & Engineering Corp., Cleveland, are fabricating frames for 15-ton erecting cranes at the rate of ten a month. When completed, the frames weigh about 8,000 pounds and contain more than 70 pieces of various grade steel. There is more than 500 feet of welding by the A-C process in each frame, too. The cranes themselves have a lifting capacity of 15 tons and are built with booms which vary in length to more than 100 feet.

» «

Welded Steel Wheelbarrow

The old wood wheelbarrow in a brick yard in the vicinity of Pittsburgh, Pa., has been replaced by a special wheelbarrow of arc welded steel. The wheel barrow of welded steel construction was built at a saving of 30% in cost and 17%

The special steel wheelbarrow (Photo Lincoln Electric Co.)

The old wood wheelbarrow (Photo Lincoln Electric Co.)

in weight, together with 100% greater strength and rigidity over conventional wooden construction.

The welded fabrication accomplished with shielded arc equipment is quite simple. Standard angles arc welded together form the framework, while short pieces of tubing are used for wheel hubs and light pipe for the handles.

» «

Electric Arc Cutting

★ The present day speeding up production has recalled to Mr. C. J. Holslag of Electric Arc Cutting & Welding Co., Newark, N. J., methods used in World War I to increase production. Mr. Holslag states that during the last war that in the production of shell stock batteries of twenty to thirty power hack saws were replaced by nick break machines as pictured at the right.

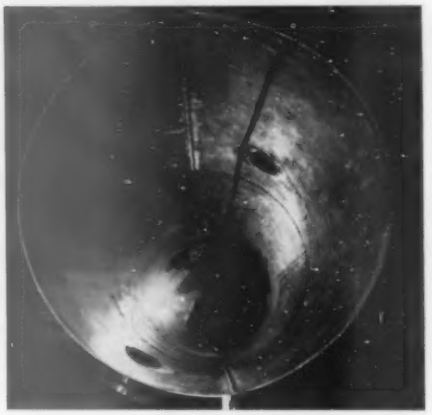
At the same time it was discovered that electric arc deseaming of billets was quite sucessful when an electrode coated with an oxygen liberating compound was used.

» «

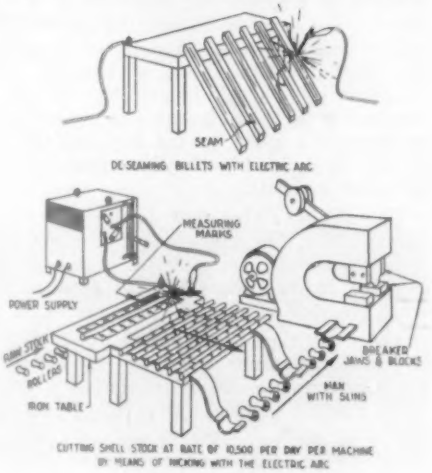
Welded Copper Clad Tank

★ When a 1000-gallon tank was needed to hold the water supply of a boys' school in Connecticut, it was decided to utilize the corrosion resisting qualities of copper clad steel by making the tank of that material, with the copper surface on the inside. The fabricating contract was placed with Gerstein and Cooper Co., South Boston, Mass., who have specialized in copper work for about forty years. The tank is 14 ft. long by 3½ ft. in diameter. Three rings, each made up of two formed plates, comprise the shell. The dished heads are one-piece and were formed in the shop.

Plate edges were beveled on the steel side, tacked and welded with coated steel electrodes. Then the reverse (copper) side was chipped to remove all slag and icicles, and the final weld was made with the carbon arc, using a Wilson 200-amp. generator and a copper silicon filler rod. All welding was done by operators who had qualified under insurance company tests, and when completed the tank was tested at 300 psi.



Carbon arc welding head seam on inside of tank. (Photo Wilson Welder and Metals Co., Inc.)


SEAM
DE SEAMING BILLETS WITH ELECTRIC ARC
MEASURING MARKS
POWER SUPPLY
RAW STOCK
ROLLERS
IRON TABLE
BREAKER JAWS & BLOCKS
MAN WITH SLING
CUTTING SHELL STOCK AT RATE OF 10,500 PER DAY PER MACHINE BY MEANS OF NICKING WITH THE ELECTRIC ARC

THE TECHNICAL SLANT

"EDUCATION IS KNOWING THE ANSWER OR WHERE TO FIND IT"

Arc Welding

ARC WELDING HANDBOOK. *By Karl Meller, translated by J. E. Webb Ginger. Distributed by Chemical Publishing Co., Inc., New York, 1937. Cloth, 5 x 7½ in., 210 pages. Price $3.50.*

This book is an English translation of a German Arc Welding Handbook; as such, it presents some interesting sidelights on German arc welding problems of several years ago. There is covered information on: welding processes; physical nature of the arc; welding equipment; welding electrodes; the welding of steel, cast-iron and non-ferrous metals; and the testing of welded joints.

There is included considerable data on cost and, as strange as it may seem to the American welder, the author frequently recommends that bare electrodes be used on the account of their cheapness. It is not known whether this is the current welding practice in Germany but in view of the superior welds obtained from coated electrodes, it would seem unwise.

» «

Engineering English

HANDBOOK OF ENGLISH IN ENGINEERING USAGE. *Second Edition. By A. C. Howell. Published by John Wiley & Sons, Inc., New York, 1940. Cloth, 5 x 7½ in., 433 pages. Price $2.50.*

Professor Howell's revised book will make a valuable addition to any engineer's library. As Dr. C. E. Kettering brings out in a letter to the author which is quoted in part, "Success in engineering and research depends as much upon the ability to present ideas convincingly as it does upon the ability to perform calculations and experiments."

This book, while designed as a handbook for the practicing engineer, is also intended for use as a text in college courses in English for engineering students. As such it covers the material engineering schools. Regardless of the fact that the "Handbook of English in Engineering Usage" is suitable for an English text book, it has been written to serve as a guide for the engineer who wishes to make his English clear, concise and accurate.

The author states that during the ten years which have intervened since the writing of the First Edition, that many changes have occurred in technical writing styles necessitating a revision.

These changes in style are illustrated by citations from recently published engineering articles.

In addition to presenting a thorough background in "engineering" English, there are included several chapters that will be of special interest to the executive engineer. These are the chapters on business letters, technical reports and technical magazine writing; the latter will be particularly helpful to those wishing to do technical writing for publications.

» «

Fifth Column

THE FIFTH COLUMN IN WASHINGTON. *By Joseph P. Kamp. Published by Constitutional Educational League, Inc., New Haven, Conn., 1940. Paper, 6 x 9 in., 34 pages. Price 25 cents.*

The Fifth Column in Washington cannot be called a technical book in any sense of the word, yet it contains much information of interest to technical men. The author has endeavored to point out that "In Europe, the Fifth Column is in disguise. With us, the Fifth Column is in Office."

Names are given as well as biographical backgrounds of several cabinet officers and other important personages in key government and defense positions. In each case they are linked with subversive and popular "front" movements.

The entire 34 pages of this booklet contain enlightening and startling information that will make the reader wonder if it "can happen here" as it did in France.

» «

Management

PRODUCTION MANAGEMENT. *By A. M. Simons, reviewed by Henry Post Dutton. Published by American Technical Society, Chicago, 1940. Cloth, 6 x 9 in., 588 pages. Price $3.50.*

Written with efficiency in production as the main thought, this book is designed to provide practical suggestions on problems of industry location, plant layout, factory and office management and personnel. It is pointed out that efficient management in this present day of mass production can be obtained only by coordinating the many factors encountered in such an organization. Included as a part of the book are charts, tables and other illustrations to assist the reader in more clearly understanding the various phases of the material presented.

» «

Success

THE KNACK OF SELLING YOURSELF. *By James T. Mangan. Published by The Dartnell Corp., Chicago, 1938. Cloth, 5½ x 8½ in., 234 pages. Price $2.50.*

The Knack of Selling Yourself is one of the most vigorous of the "success books" that have come to the attention of this reviewer. The author has broken down the pre-requisites for success into eight qualities and has listed them, in what in his opinion is their order of importance: (1) Expression, (2) Promise, (3) Guts, (4) Approach, (5) Diplomacy, (6) Familiarity, (7) Reliability and (8) Persuasiveness.

As you read through this book and reflect, thinking of the successful men of this day, you realize that Mr. Mangan has undoubtedly found the key to success. But you will also realize that for you to find the key you will have to abandon some of your concepts of fair play; as to whether you are able to do so will depend upon how much of Mr. Mangan's quality No. 3 you possess.

In the Knack of Selling Yourself is found many excellent thoughts and even though you may not approve of the author's means to an end you must admit that he is right in nearly every instance.

» «

Dredge Welding

"Ten ways to Cut Dredging Cost" is the title of new 32-page booklet released by the **Stoody Company,** Whittier, Calif.

This is believed to be the first comprehensive coverage of the subject of dredge maintenance welding to have ever been published. Differing from many company releases, it has been prepared by an authority on dredge maintenance based upon many years of experience in the practical application of welding and hard-facing in the maintenance of dredging equipment.

In the booklet is explained, with the assistance of photographs and drawings, the fixtures, metals and methods which have been used by dredging concerns in the rebuilding and hard-facing of this equipment.

Aside from illustrating many before and after applications of hard-facing, the unique feature of "Ten Ways to Cut Dredging Cost" is the inclusion of seven drawings of jigs and fixtures used in reclaiming dredge pumps, impellers and cutters. These drawings alone will make this a valuable booklet for the dredging industry.

Readers of the **Welding Engineer** may purchase the above books direct from the Welding Engineer Publishing Co., 506 So. Wabash Ave., Chicago, Ill. if they so desire.

A "Wheel of Progress" Keeps Moving

THANKS TO TOBIN BRONZE!

This 2½ ton gear, although broken in several places, was back on the job only six days after it failed

This gear looked something like Humpty-Dumpty... it was so severely broken that it looked almost impossible to repair. But, here, as in many other emergencies, Tobin Bronze repair welding performed the "impossible," in the shortest possible time.

Not only does Tobin Bronze make strong, sound welds in cast and malleable iron and steel, but because of Tobin Bronze's low melting point, its use effects large savings in preheating time and fuel consumption. There is a minimum of delay in returning a Tobin Bronze welded part to service.

Tobin Bronze rods are stocked by leading jobbers throughout the country. When ordering, make sure you get genuine Tobin Bronze. Each rod is trademarked for permanent identification.

•

The Hebeler Welding Co., Buffalo, N. Y., repair-welded this 2½ ton gear in 64 man hours with 250 lbs. of Tobin Bronze. 46123

ANACONDA
from mine to consumer

Anaconda Welding Rods

THE AMERICAN BRASS COMPANY, General Offices: Waterbury, Connecticut

In Canada: Anaconda American Brass Ltd., New Toronto, Ont. • *Subsidiary of Anaconda Copper Mining Company*

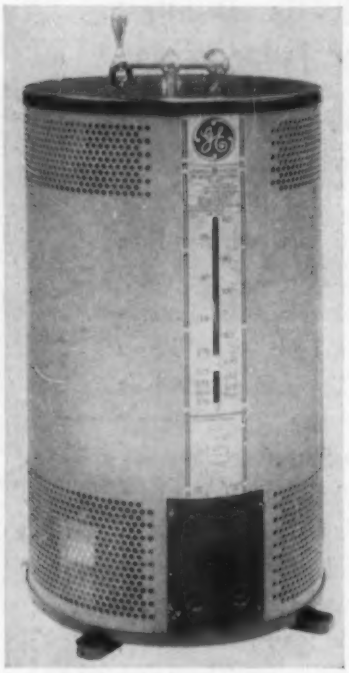
New Product Developments

CORRECTION!

New Aircraft Welding Torch

★ The new **Series "9" Aircraft Welding Torch** manufactured by the **Dockson Corp.**, 3839 Wabash Ave., Detroit, Mich. was described on page 70 of the October issue of *The Welding Engineer* as having duralumin tips. The description should have read "duralumin tip tubes with copper tips."

» «



Low maintenance claimed for this welder.

G-E Adds 300-Ampere A-C Welders

★ The **General Electric Co.** has added a new **300-ampere arc-welding transformer** with built-in power-factor correction to its line. As in the 500-ampere welder previously announced, this new size offers all the advantages of high power-factor without sacrifice of stability or performance. It is claimed that not only is useless lagging current practically eliminated under load, but at light loads or no load, power-factor correction for other plant load is provided. It is claimed that smaller line cable, line switches and fuses can thus be used. This often results in savings on installation costs or makes possible the addition of more welders to existing feeders without causing overload.

Other advantages of this new 300-ampere welder include: finger-tip current adjustment; large, easily-read current indicators; protected output terminals; and fan-forced ventilation. The refinement of design permits reduction in size, weight and floor-space requirements. Thus the new welder is only 43 inches in height, only 21 inches in diameter, and has a net weight of only 450 pounds. The only maintenance said to be required is lubrication of the fan and current-adjuster every 12 to 18 months, which can be done without removing the case of the welder.

» «

New Silver Solder Flux

The **Superior Flux Co.**, 913 Public Square Bldg., Cleveland, Ohio, announces the new **Superior Silver Solder Flux No. 6** for silver soldering both ferrous and non-ferrous metals, including stainless steel, high carbon steel, Monel, nickel, Inconel, copper, beryllium-copper, aluminum bronze, brasses and bronzes. This flux is a concentrated paste flux which is said to induce deep solder penetration; also floats oxides to the surface, resulting in strong leak proof joints.

» «

Acme Air Operated Spot Welder

★ A complete line of air operated rocker arm type spot welders in transformer capacities of from 10 KVA to 75 KVA is announced by the **Acme Electric Welder Co.**, Huntington Park, California.

These spot welders come completely equipped with automatic weld timers and welder service magnetic contactors and are offered in various styles actuated by a foot valve and limit switch, by a solenoid operated mushroom type floor switch, or by a specially designed two stage toe operated floor switch. They are available in either single spot non-beat or automatic repeat operation.

The advantages claimed to be offered by air operated spot welders are faster production, uniform spot welds and the elimination of operator fatigue.

This Acme spot welder has 48 points of heat regulation.

A few distinctive features of these new spot welders include heavy fabricated steel bases, transparent bowl pulsating type lubricators, jewelled pressure gauges, bronze pressure regulators, test switches and piston packed air cylinders. Heat regulation is available from 6 points to 48 points. Every Acme welder carries a Lifetime Guarantee against defects in material or workmanship.

These welders are described in Bulletin No. 52 which is available on request.

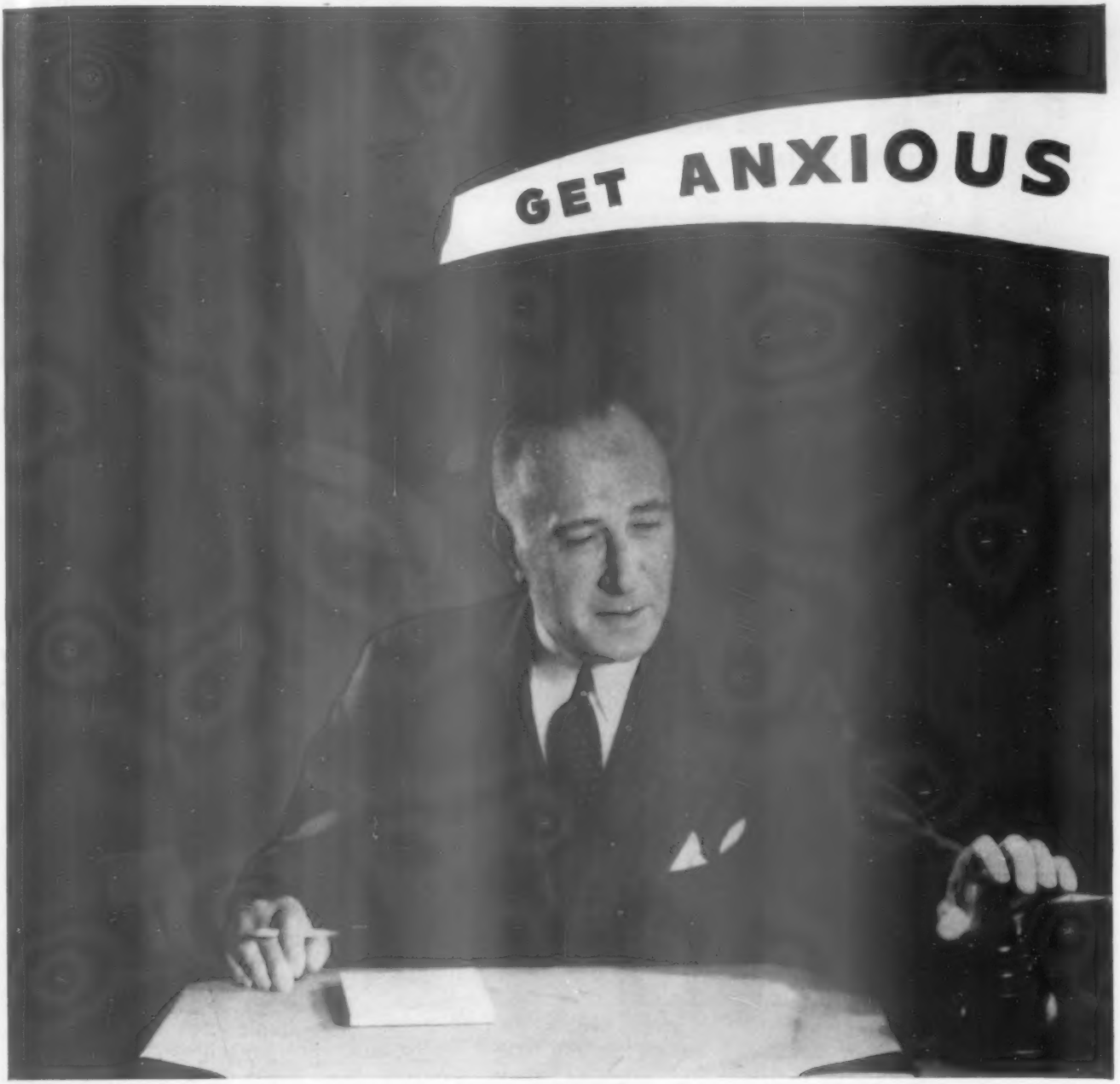
» «

Metal Fume Respirator

★ **The Mine Safety Appliance Co.**, Braddock, Thomas and Meade Sts., Pittsburgh, Pa., announce a new Bureau of Mines approved respirator for protection against metal fumes produced when cutting or welding galvanized iron. Known as the **M.S.A. Comfo Metal Fume Respirator,** the unit provides complete working freedom, permitting use of goggles or headgear of any kind without interference.

Welders can wear this respirator and goggles at the same time.

Construction features are: Filters of unique design, having high filtering efficiency against fine metal fumes; Filter area more than double that of regular Comfo dust filters; Aluminum filter containers, assuring long filter life by keeping out grease and dirt; All-rubber facepiece which fits any face snugly and comfortably; Foolproof U. S. Army-type exhalation valve—simple and positive in action. Additional information on the M.S.A. Comfo Metal Fume Respirator may be obtained by request from the makers.



ALTER EGO: Literally "one's other self"—the still, small voice that questions, inspires and corrects our conscious action.

ALTER EGO: Can't you make up your end of our mind to settle on Lincoln machines?

Not yet, because I can't be sure that two controls on arc welders are necessary.

ALTER EGO: How can you possibly be sure when you don't understand?

But, I hear that other machines do well with just one control.

ALTER EGO: Listen, when a man no longer is *anxious* to do better than WELL—he's done for.

All right. For the sake of argument, call me anxious.

ALTER EGO: OK—now let's put it up to Lincoln.

• •

LINCOLN SUGGESTS: Dual Continuous Control of "Shield-Arc" Welders is the ONLY WAY to fit the arc to the job—and to do each job the way it should be done. Its "Job Selector" gives you any TYPE of arc. Its Current Control gives you any arc INTENSITY. Result: You get maximum welding speed and maximum weld quality at all times. This new arc welding technique—what it means to *you*—is explained clearly in Bulletin 412.

LINCOLN "SHIELD-ARC" WELDING THE LINCOLN ELECTRIC COMPANY Cleveland, Ohio

Largest Manufacturers of Arc Welding Equipment in the World

WELDERS OF STAINLESS!

FREE ARCOS POCKET GUIDE
OF NEW STAINLESS WELDING DATA!!

1. DEPOSITION RATE GRAPH—estimate accurately quantity of stainless electrodes needed, and time required for any stainless welding job. 2. DATA on all important chrome and chrome-nickel alloy weld metal including types of service for each grade, and recommended heat treatment. 3. COMPLETE LIST of Arcos stainless electrodes and chemical analysis of weld metal obtained. 4. CURRENT RANGE for each size of electrode shown on graph.

Bulletin No. 4

Write TODAY for your free copy

it's ARCOS for welding stainless

FOR INFORMATION WRITE ARCOS CORPORATION Dept. B., 401 N. Broad St., Phila., Pa.

Thin Stainless

(*Continued from page 31*)

tively prevent distortion. All welding is done by the atomic hydrogen process. The welding technique with this process preserves the physical properties of the parent metal and leaves a minimum amount of deposited metal to be removed in the finishing operations. This is important because of the spoilage hazard that would be involved if extensive grinding were needed to get rid of excess deposit.

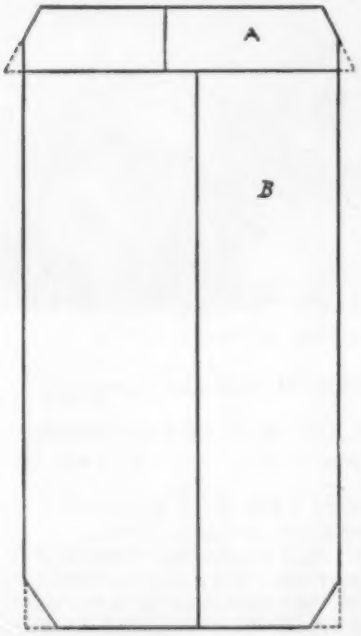


Figure 2—Only two pieces of sheet are used in making this shell.

The locating spuds, easily seen in Fig. 1, are turned from stainless steel rod stock, and attached to the shell by silver brazing.

There are seven steps in the finishing cycle. The first four passes are on cloth wheels with emery

Figure 3—A hollow stainless steel milk float.

numbers 120, 180, 240 and 320 respectively, then a brush, and finally two buffing passes. When finished the welds are entirely invisible.

A somewhat more exacting job is shown in Fig. 4. This is a hollow float, 15 in. in diameter, shaped like a discus, with a circular hole in the center. The float is made from three pieces of stainless steel sheet. The two main parts of the shell are spun with flanged edges on the outer periphery, and these edges are fused by the atomic hydrogen torch. There is an inner ring inserted between these main shell segments at the center to give the required bulge. This calls for one butt weld to form the ring and two circumferential butt welds to join it to the shell. These three welds are finished perfectly smooth and flush with the sheet. The slight bulge noticeable around the outside edge of the float is the bead formed by fusing the flanged edges of the main sections. It is not considered desirable to grind off this bead to a flush finish, because although made from very thin material this float is distinctly a pressure job. In service it is subjected to sudden changes of temperature from just above freezing to steam temperature (212 deg. F).

These two fabrications have been chosen as illustrative of the precision craftsmanship that is involved in working thin sections of stainless, and the photographs of the finished articles show how well it can be done with adequate facilfacilities and with practiced techniques.

» «

Spot Welding

(*Continued from page 32*)

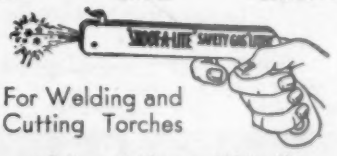
loads the work at the left of the station, he rolls the jig to the right and into welding position. Following the welding he returns to starting position at left. Thus, two operators at each welding station alternate with each other at the welding position, each loading and unloading at his own position without interference.

Facilitating rapid loading and unloading, no hand clamps are used or needed — clamping being done by the wedges of the upper electrode. The jig was also designed so that parts can be "dropped" into position, thus eliminating the time-consuming necessity of "fitting" parts in place.

While production of 100 grille halves per hour is expected to fulfill requirements, it is possible to step up production by adding additional loaders at each station, no changes in the machine itself being required.

The Practical Lighter

SAFE! SURE! STRONG!



For Welding and Cutting Torches

Ask Your Jobber or Write Us

SHOOT-A-LITE CORP.

118 East 28th St. New York, N. Y.

New Product Developments

New 2 S Aluminum Electrode

★ **Universal Power Corp.**, 4300 Euclid Ave., Cleveland, Ohio, announces as an addition to its aluminum arc welding electrodes known generally as "Luminarc" a new electrode suitable for arc welding on 2 S aluminum where the deposit and parent metal are to be anodized and where a good color match of weld and base metal when anodized is desired. Because of its application this product is known as **Luminarc 2S.**

This electrode is said to be especially useful to makers of ornamental aluminum welded products used in modern buildings and structures.

» «

Pipe Anglemeter

The **Wolfe Angle Meter,** which is distributed by the **Interstate Sales Co.,** 1123 Broadway, New York City, is a new "slide rule" for the welding and sheet metal industry. It has ben developed to provide the man on the job a quick means for laying out the cut for any angle from 0 to 90 degrees on either pipe or flat material. It has been computed for pipe diameters from 1 to 20 in.

Using a method of measuring in both directions from a center line, it requires only 4 measurements to mark a pipe or stretch out in 16 different points on the circumference. All measurements are taken from the right hand side of the pointer to the zero line.

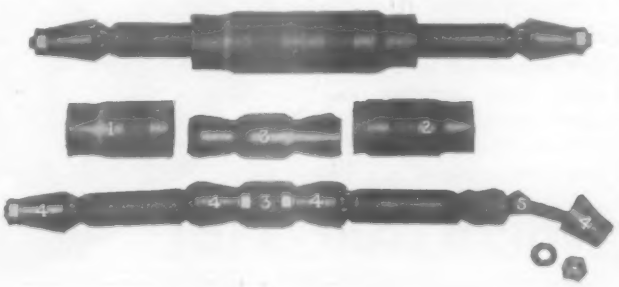
Where the lines are not calibrated, a rule is placed with the end against right hand side of pointer and the measurement read at the zero line. The rule should be held parallel to the nearest existing horizontal line.

» «

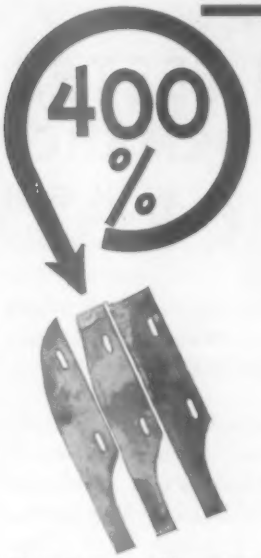
Welding Cable Connectors

The **Jackson Electrode Holder Co.,** 15122 Mack Ave., Detroit, Mich., announces the new **Jackson Cable Connector.** This fully insulated, ruggedly constructed connector is 5⅞ in. long and 1⅞ in. in diameter and is suitable for various size arc welding cables from No. 1 to 4/0.

These connectors are said to lock the cables so positively that they cannot part under the most severe conditions; yet, at the same time they are quickly and easily attachable and detachable. Sold in pairs — positive and negative. Insulator housings on positive are red —negative, black.



This cable connector is suitable for No. 1 to 410 cable.



These bottom mill scrapers used in the plant of a sewer tile products company graphically illustrate the increased service life that is possible by Coating with Coast Metals. Uncoated scraper (left) is worn beyond use after 8 WEEKS service. Coated scraper (center) shows only minor wear after 9 MONTHS service. Compare new scraper (right) coated ready for service.

increased life for wearing parts

Coast Metals have been perfected to increase life of wearing parts subjected to (1) abrasion, (2) impact, or (3) high temperature. The bottom mill scrapers illustrated are typical. The scraper (center) faced with Coast Metal No. 101 shows only minor wear after 9 **months** service. Compare it with the uncoated scraper after only 8 **weeks** service. The worn faced scraper can be easily and cheaply rebuilt to proper size with Coast Metal for many more months of service.

There are 11 types of Coast Metal Hard Facing Rods for easy application by the oxy-acetylene torch or the electric arc. They can be applied to any ferrous metal, including alloy steels, manganese steel, cast or chilled irons.

WRITE FOR DESCRIPTIVE LITERATURE AND NAME OF LOCAL JOBBER.

COAST METALS, Inc.
1006 McKinley Ave. S. W.
CANTON, OHIO

News of the Industry

The 14th **National Exposition of Power and Mechanical Engineering** will be held at Grand Central Palace, New York City, December 2-7, 1940. During the same week the **American Society of Mechanical Engineers** will hold their annual meeting at the Hotel Astor while the **American Society of Refrigerating Engineers** will be meeting at the Hotel Commodore.

One of the outstanding exhibits of the Power and Mechanical Engineering Exposition will be an exhibit of the first coated, high-aluminum-bronze weld rod to be placed on the market. This rod is said to be economical and efficient for making repairs, it also is claimed to have a special use in coating the surfaces of large forming dies and other equipment, the object being to obtain the surface properties of a part cast solid from the same material, at a marked saving in cost.

More than 290 exhibitors have reserved space at the Show, registering about 1,200 different products to be shown under upward of 300 classifications.

The Show, at which an attendance of more than 40,000 visitors is expected, will open at two o'clock on Monday, December 2, and at 11 a.m. on succeeding days of the week. It will remain open until 10 o'clock each evening except Wednesday and Saturday, when the closing hour will be six. Admission is by registration and invitation only.

» «

Civil Service Examinations:

More **Procurement Inspectors** are needed at the Air Corps, Wright Field, Dayton, Ohio, for the following branches of inspection: Aircraft, engines, instruments, parachutes, aircraft propellers, and tools and gages.

The Civil Service Commission has been asking experienced men for these jobs but it announces that a new type of position has just been added to those to be filled — that of Junior Procurement Inspector, $1620 a year. The upper grades pay from $2000 to $2600 a year. (All salaries are subject to a 3½ percent deduction for retirement annuity.)

For the junior grade, college graduation in engineering may be substituted for experience as follows: Graduates in aeronautical engineering will be eligible for aircraft, engines, instruments, and propellers, graduates in mechanical

YOU GET

JOB-TESTED PERFORMANCE WITH G-R!

Experience on the job — month after month of daily, 2 and 3-shift production welding — PROVES you get safe, reliable performance PLUS savings up to 50% in power cost with G-R welders.

For over a year these three 60-ampere G-R model 45's have put in 2 shifts daily on high-amperage production welding.

There's a size to fit YOUR job—seven models from 125 to 1250 amperes, plus 2000 ampere units for UNION-MELT and automatic head welding.

GET THE FACTS — WRITE TODAY FOR FREE LITERATURE

GLENN · ROBERTS COMPANY, INC.

1009 FRUITVALE AVENUE • OAKLAND, CALIFORNIA, U S A

engineering will be eligible for engines, instruments, and tools and gages; graduates in electrical engineering will be eligible for instruments.

For the upper grades, mechanical experience, which may include aprenticeship, is required in the branch applied for except that the experience on engines, instruments, and tools and gages need not have been in aircraft work. In fact, for engines, mechanical experience on construction or machining of engines or as a machinist or toolmaker working to close tolerances using precision instruments or measuring devices will be acceptable. College courses in engineering may be substituted for a part of the experience for the upper grades.

Applicants will not be given a written test. They will be rated on their education and experience as shown in their applications, subject to verification by the Commission.

This work is an important part of the National defense program. Apply for details to the Secretary, Board of U. S. Civil Service Examiners, Wright Field, Dayton, Ohio; to any first- or second-class post office; to the U. S. Civil Service Commission, Washington, D. C., or to any of the Commission's district offices.

» «

U. S. Civil Service Commission Announce Toolmakers Examination — To meet the great demand for toolmakers for the National Defense Program, the United States Civil Service Commission urges qualified persons to apply for this position. Applications will be rated as received at the Commission's Washington office until further notice. Immediate appointments are to be made at ordnance and naval establishments in Philadelphia, Pa.; Boston, Springfield, and Watertown, Mass.; Watervliet, N. Y.; and Washington, D. C. Approximately 600 appointments will be made in the Frankford Arsenal alone. The pay scales vary according to the place of employment, ranging from $6.24 a day to $1.17 an hour.

Applicants must have completed a 4-year apprenticeship as toolmaker, or must have had 4 years of practical experience in the trade. They must be able to read blueprints and must be experienced in the use of precision gages, measuring instruments, etc.

Further information as to the requirements for this position and application forms may be obtained from the Secretary of the Board of U. S. Civil Service Examiners at any first-or second-class post office, or from the U. S. Civil Service Commission, Washington, D. C.

» «

Personals

The appointment of **W. M. Black** as president of the **American Manganese Steel Division** of the American Brake Shoe & Foundry Co., was announced by W. B. Given, Jr., President, at a meeting of the Board of Directors, October 8, 1940.

Mr. Black became General Sales Manager of this Division in 1934 and a Vice-President in 1935. He has been with "Amsco" since 1912, with the exception

W. M. Black

The Improved "Round File" Gas Lighter

Locking "Slip-on" Renewal

—an exclusive feature

The patented cartridge holding the spark metal locks exactly in correct position, permitting instant replacement.

Get acquainted with the many other superior, exclusive features of Improved "Round File." *Circulars and prices on request.*

SAFETY GAS LIGHTER CO. (Est. 1901) LYNN, MASS.

What Load Will a Welded Joint Carry Safely?

By R. J. HOFFMAN

Estimated safe loads on arc-welded joints may be obtained readily from the accompanying alignment chart without having to make tedious calculations. It is constructed on the basis of accepted stresses of 13,000 lb. per sq. in. for tension, 15,000 lb. per sq. in. for compression, and 11,300 lb. per sq. in. for shear, all loads acting through the center of gravity of the section; eccentricity would increase the stresses beyond the uniformly distributed stresses assumed.

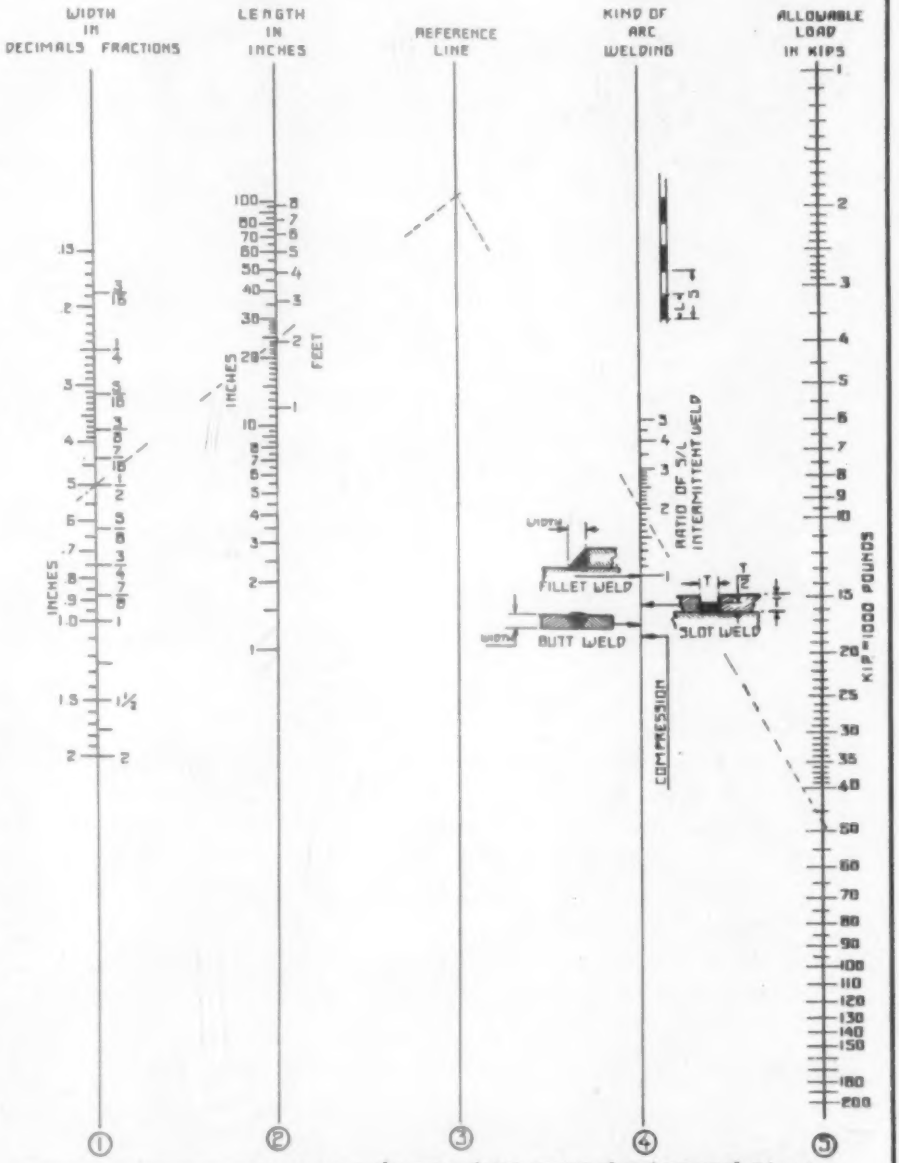
For shear calculations, the cross-sectional area is to be taken through the throat of the fillet weld; this inconvenience to the estimator is eliminated by assuming that the fillet weld has always the form of an isosceles triangle of 45° and that the throat dimension is replaced by the leg dimension, thereby reducing the allowable stress to 8,000 lb. per sq. in. for the area of the fused surface—usually the length of the weld times the plate thickness.

The chart estimates the allowable loads on arc-welded connections for fillet welds, intermittent fillet welds, butt welds, and slot welds.

For convenience, the chart is appended with a specific example, for which the lines are marked on the scales. In order to preserve the chart it is only necessary to lay a straight edge across the scales and place a pencil point at the intersection of the two lines on the reference line.

This chart can be used if any three factors are known and the fourth one to be found. Though the example given at the foot of the chart has to do with determining the allowable load, the chart can also be used for other calculations.

For example, to find the length of the weld necessary which will hold a certain load, if the width and the kind of weld to be used is known, we connect the values on scale No. 5 and scale No. 4, intersecting the reference line; then we connect the intersection point with the width on scale No. 1 and find the length required on scale No. 2. Other problems like the finding of the spacing of intermittent welds if the length, the thickness and the load are given, are also easily solved.


WIDTH IN DECIMALS FRACTIONS
LENGTH IN INCHES
REFERENCE LINE
KIND OF ARC WELDING
ALLOWABLE LOAD IN KIPS
INCHES
FEET
RATIO OF S/L INTERMITTENT WELD
FILLET WELD
BUTT WELD
SLOT WELD
COMPRESSION
KIP = 1000 POUNDS
EXAMPLE: INTERMITTENT FILLET WELD, TWO ½" PLATES 24" LONG - FILLETS 2" LONG SPACED 4" S/L = 4/2 = 2
CONNECT ½ ON SCALE NO 1 WITH 24 ON SCALE NO 2 INTERSECTING REFERENCE LINE NO 3, THEN CONNECT
INTERSECTION POINT ON LINE NO 3 WITH 2 ON SCALE NO 4 INTERSECTING SCALE NO 5 THRU 48 KIPS
THE ALLOWABLE LOAD IS 48 KIPS OR 48,000 POUNDS.

of the war years when he served as a Lieutenant in the U. S. Ordnance Department.

The American Manganese Steel Division was formerly headed by W. E. Crocombe. Mr. Crocombe remains president of the American Forge Division of the company which is now undertaking the production of upset shell forgings in addition to its regular business, to which has also been added the products of the Great Lakes Forge Company of Chicago, recently purchased.

The American Manganese Steel Division has six plants throughout the country, the largest of which is located at Chicago Heights where Mr. Black is located. The division manufactures a wide range of manganese steel castings, material handling pumps, heat and corrosion resistant alloys and special welding rods.

» «

C. B. Ketcham has been promoted to manager of the Cincinnati, Ohio office and **C. G. Jewett** becomes manager of the Columbus, Ohio office of the **Westinghouse Electric & Manufacturing Co.**, according to J. K. B. Hare, central district manager for the Company.

Mr. Ketcham takes over his new duties after 10 years as manager of the Westinghouse office in Columbus. He will succeed the late F. R. Colville. During nearly 30 years with the Company, Mr. Ketcham has been salesman and manager in Indianapolis, Louisville, Dayton, and Columbus. In this time he has become widely known in the central station industry in his territory. Born in Marshall, Texas, he attended the Alabama Polytechnic Institute. He is a Shriner and a member of the Rotary Club. During World War I, he was an officer of the Engineers' Corps of the Army.

Mr. Jewett's promotion follows his 15-year association with the Cincinnati office, where he has recently held the position of central station supervisor.

» «

* **George H. Bucher,** president of the Westinghouse Electric & Manufacturing Co., Pittsburgh, Pa., and 15 other employes at the Company's Pittsburgh offices received gold emblems in recognition of 30 or more years' service with Westinghouse. **A. W. Robertson,** chairman, presented the awards.

More than 21,000 other Westinghouse employes who have been with the Company 10 or more years are receiving similar awards this year.

Mr. Bucher, **Ralph Kelly,** vice-president in charge of sales; **Roscoe Seybold,** vice-president and comptroller, and **H. F. MacLane,** director of financial accounts, were among those who today received 30-year gold service buttons. **L. W. Lyons,** treasurer, received a 35-year button and **H. N. Mathias,** general cost accountant, a 40-year ruby and gold emblem.

Roland R. Davis, Thomas R. Langan, F. C. Gheen, F. L. Lee, J. W. John, and **J. A. Dickey** were given 35-year emblems; and 30-year buttons were presented to **W. D. O'Connell, W. J. Otterson, H. E. Brunk** and **Miss Ella G. Richardson.**

Mr. Bucher has been with Westinghouse since 1909, when he enrolled as a member of the graduate students' training course at the company's East Pittsburgh Works. He began at a wage of 18 cents an hour, winding coils in the shop. He was elected president in 1938.

Mr. Kelly also joined the company in 1909, following his graduation from Harvard University. Mr. Seybold enrolled in the company's graduate students' training course in 1908 and was elected vice-president and comptroller in 1934. Mr. Lyons has been with Westinghouse since 1903.

» «

Dr. C. Guy Suits, 35-year-old research physicist, has been appointed assistant to the director of the **General Electric Research Laboratory.**

The post is a new one and will permit Dr. Suits to continue his research while assuming some administrative duties, explained Dr. W. D. Coolidge, director of the Laboratory, in making his appointment.

Dr. Suits has been a member of the Laboratory staff since 1930 and is widely known for his research in high-temperature arcs. He has produced some of 18,000 degrees, Fahrenheit, the hottest on record and twice the temperature of the sun's surface. Many of his 52 patents are in this field.

In the course of Dr. Suits' research on arcs, he developed a means of measuring

TITAN Provides the Correct Alloy for Every Oxy-Acetylene Bronze-Welding Purpose

TITAN Alloys—doubly-deoxidized to protect against formation of gas and oxides—give the best results for all oxy-acetylene welding and brazing applications:

Penn Bronze—is a general purpose rod. It is low melting (1620°F.) and tins easily and uniformly on galvanized, malleable or wrought iron as well as steel, brass, bronze and any other non-leaded metal with a melting point above 1850° F. It makes tough high-strength welds of high ductility, immune to strain hardening and with great abrasion and corrosion resistance.

Titan Manganese Bronze—is used where both hard and tough welds are desired. Although this is a general purpose rod, it is especially recommended for cast iron. It is free flowing and gives extremely dense, non-porous welds.

Titan Bronze—is a tin bronze with uses and characteristics similar to the manganese alloy; penetrates seams and crevices readily.

TITAN METAL MANUFACTURING CO., BELLEFONTE, PA.

TITAN BRONZE WELDING ALLOYS

their temperature by photographing sound waves passing through them. His work on the subject has helped in the understanding of welding arcs and has contributed to the development of more effective circuit breakers for the protection of power lines.

Trade News

★ **Anderson & Sons** who were formerly located in Springfield, Mass. have recently moved to Westfield, Mass. They now have one of the largest and most up-to-date plants in the country for producing all types of decorated metal products by the etching, lithographing and embossing processes—all on one floor.

Some of their items include name plates, dials, escutcheons, charts, and a great variety of articles used as advertising specialties, and premiums. All kinds of metals are used, and a great variety of finishes are obtained.

» «

Martin Electric Co., Detroit, manufacturers of resistance welding transformers, is completing an addition to its new plant on E. Outer Drive. According to **William H. Martin,** President, the new addition doubles the manufacturing floor space and will add more than 100% to production capacity.

Significantly, the new addition is nearing completion within a year of the time the original factory was occupied. The company has been operating on a 24 hour basis for the past six months.

» «

Welding Equipment & Supply Co. of Detroit announces the removal of its offices and plant to 223 Leib Street, Detroit, Michigan, October 15th, 1940.

INCREASE PRODUCTION . . .

with the NEW

DOCKSON

Featherweight

SERIES "9"

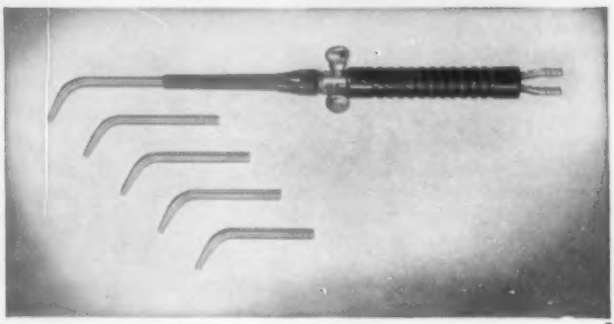
AIRCRAFT WELDING TORCH

●

A Trial will prove the merits of this new and unusual torch.

●

See Your Dockson Distributor or write



WEIGHS ONLY 5 OUNCES

Fibre handle insures cool grip at all times. Spring tension valves located at finger tips for instant one hand adjustment. Duralumin tip tube with full range of tips from 1 to 6 inclusive.

DOCKSON Corporation

WELDING & SAFETY EQUIPMENT

3839 WABASH AVE. • DETROIT

WELDING AND CUTTING TORCHES
REGULATORS
ELECTRODE HOLDERS
HELMETS - GOGGLES
ACCESSORIES
FACE SHIELDS

Obituary

M. Keith Dunham, Chairman of National Cylinder Gas Co. died at his home in Montague, Michigan Sept. 29th, 1940, as a result of a heart attack suffered in June. He had been associated with the oxy-acetylene industry during the greater portion of his life and was one of the first to recognize the worth and promote the use of the oxy-acetylene process.

Mr. Dunham was born Oct. 18, 1882 in Canada and was brought to the United States at an early age. His first

M. Keith Dunham

association with the industry was in 1908 in Boston, Mass. when he started to work on the development of apparatus for use with oxygen and acetylene, and at the same time ran a job welding shop under the name of Waterhouse Welding Co. From 1915 to 1917 he did consulting work on problems associated with the industry. During this time he also wrote many articles for trade publications and a book entitled

GREYHOUND

CUSTOM BUILT

TRANSFORMERS WOUND WITH DOUBLE WOVEN SPUN GLASS MAGNET WIRE

●

ASBESTOS AND MICA INSULATION

●

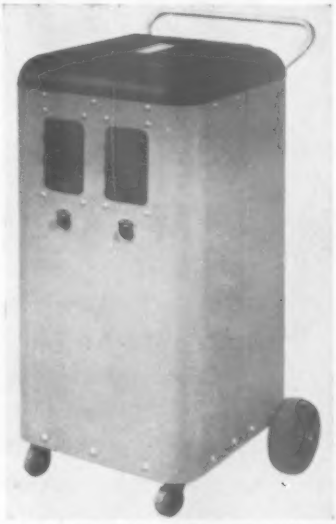
CONTINUOUS WELDING

●

5-YEAR GUARANTEE

●

5 MODELS RANGING FROM 100 TO 300 AMPERES



A. C. ARC WELDERS

AUTOMATIC VOLTAGE CONTROL

●

ELECTRICALLY BALANCED

●

ENGINEERED FOR A LIFETIME OF CONTINUOUS SERVICE

●

PRICED $55.00 TO $275.00 COMPLETE WITH ALL ACCESSORIES

■

INDUSTRIAL MODEL S.P. 300

28 Continuous Welding Ranges 15 to 300 Amperes

JOBBERS' INQUIRIES SOLICITED, EXCLUSIVE TERRITORIES AVAILABLE.

Manufactured By

GREYHOUND ELECTRIC MFG. CO., INC.

31 GRAND STREET
BROOKLYN, N. Y.

"Automobile Welding—With the Oxy-Acetylene Flame."

In 1917 he became associated with Bastian-Blessing Co. as Chief Engineer in which capacity he designed the original Rego line of welding and cutting apparatus. At this time he also developed and patented the balanced pressure principle for oxy-acetylene torches. He left the Bastian-Blessing Co. in 1921 to go in business under his own name selling and engineering liquefaction oxygen equipment.

In 1924 under the name of Dunham Mfg. Co. he started to manufacture monolithic filled dissolved acetylene cylinders.

In 1927 the Keith Dunham Co. was formed to transact business which was formerly done under his name. The Keith Dunham Co. was the forerunner of the National Cylinder Gas Co. as it now exists.

» «

Edward Francis Smith, 52, District Manager of Haynes Stellite Company, Chicago, Illinois, died September 26 at Rochester, Minnesota. Mr. Smith was born at Hannibal, Missouri, and learned the practical aspects of the machinist's trade in his father's shop there. He became a sales engineer with Haynes Stellite Company, a Unit of Union Carbide and Carbon Corporation, in 1920 and a few years later was appointed District Manager in the Chicago area, which position he held at the time of his death. He was well-known as an author and speaker on metallurgical subjects.

Death came suddenly to Charles A. McCune, Secretary of the Magnaflux Corp., on October 13, just four days before his 61st birthday while he was recuperating in Atlantic City. Although Mr. McCune had been seriously ill for several months as the result of a heart attack, he was considered well on the road to recovery when he left for Atlantic City.

C. A. McCune

Mr. McCune was one of the pioneers of the welding industry. From his position of Chief Draftsman of the Safety Car Heating and Lighting Company in 1904 he became Assistant Engineer and later Chief Engineer of the Commercial Acetylene Company, a position he retained until 1916. In 1905 he cooperated in successfully developing the type of cylinders used today for the safe storing and transportation of acetylene and in devising other safety devices. In 1916 he became Sales Engineer of the Page Steel and Wire Company and while in this position he continued his early investigations in the field of welding rods and electrodes for both gas and arc welding.

During the War, he served as a member of the Emergency Fleet Welding Committee and was chiefly responsible for the crystallizing of the specifications for this organization. In 1924 Mr. McCune was appointed Director of Research of the American Chain Company and after holding this position for six years, he resigned in 1930 to become Director of Research of the Welding Enginering and Research Corporation. Upon the dissolution of this corporation, he assumed the position of Director and Secretary of the Magnaflux Corporation.

Mr. McCune was one of the founders of the American Welding Society and since 1923 had served as its Treasurer. He was also a past president of both the American Welding Society and the In-

MANGANAL

Reg. U. S. Pat. Office. U. S. Patents 1,876,738—1,947,167—2,021,945

11 to 13½% Manganese Nickel Steel

WELDING ELECTRODES

BARE and TITE-KOTE

For D. C. For A. C. & D. C.

APPLICATOR BARS

ROUND, SQUARE, FLAT, SPECIAL SHAPE

HOT ROLLED PLATES

For Patching and Fabricating New Parts

CAST WEDGE BARS

For Repointing Dipper Teeth

Cracked Manganese Steel Bucket
Welded with MANGANAL Welding Electrodes.

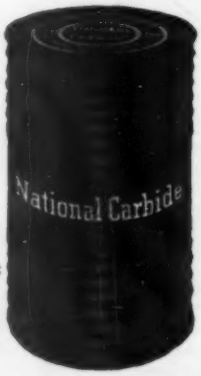
STULZ-SICKLES CO. Sole Producers 91 N. J. Railroad Ave. NEWARK, N. J.

Sold Thru Distributors Only

National

Carbide

EFFICIENT
ECONOMICAL
DEPENDABLE



Specify
NATIONAL CARBIDE
In The Red Drum
For
WELDING
And
CUTTING

NATIONAL CARBIDE CORPORATION
Lincoln Building New York, N. Y.

SIL-FOS AND EASY-FLO

BRAZING ALLOYS MEET TODAY'S NEED FOR *SPEED* WITH *RELIABILITY* IN METAL JOINING

Long before the present emergency, plants all over the country, interested in metal joining found that Sil-Fos and Easy-Flo provided reliable joints in fast time at low cost. Large quantities are now regularly used in the automotive, aviation, electrical, refrigeration, air-conditioning and coppersmithing industries and for general manufacturing. These alloys are included in Navy and Federal Specifications. To manufacturers now interested in faster production without sacrificing reliability, Sil-Fos and Easy-Flo offer an opportunity that is well worth investigating.

***They're* FAST** – Low working temperatures (Sil-Fos 1300 Deg. F. and Easy-Flo 1175 Deg. F.) plus exceptional fluidity make the brazing action so fast that a single operator often can do as much as two or more using other methods.

***They're* EASY TO USE** – Any operator can catch on to the Sil-Fos and Easy-Flo brazing technique in a few minutes. They fit in perfectly on many mass production set-ups.

***They're* RELIABLE** – Finished joints give full metal strength and are ductile and dependable where shock and vibration are severe. Millions of joints are made every year in spots where permanence ranks first in importance.

***They're* ECONOMICAL** – In your plant low brazing temperatures, instant penetration, thin films of alloy, little or no finishing, will mean savings in time, gases and materials. The cost per joint is surprisingly low.

TRY THEM ON YOUR WORK – Try Sil-Fos on non-ferrous metals and Easy-Flo on iron, steel, stainless steel, Monel, Everdur, or other ferrous or non-ferrous alloys. Easy-Flo is considered by many to be the most reliable way of joining *dissimilar* metals.

Write, today, for full details.

STEEL SALES CORPORATION

WAREHOUSES
Chicago, Ill., 3348 S. Pulaski Rd., Phone Crawford 4400
Detroit, Mich., 4150 St. James St., Phone Oregon 2121
St. Louis, Mo., 4565 McRee Ave., Phone Grand 5255

DISTRICT OFFICES
3348 S. Pulaski Road Chicago, Illinois Milwaukee Minneapolis

ternational Acetylene Association. In 1934 he was awarded the Samuel Wylie Miller Memorial Medal in recognition of this pioneering in the development of the application of fusion welding.

Mr. McCune was the author of numerous papers on acetylene and its uses, the metallurgy of welding rods and welds, the manufacture of iron and steel wire and research methods in iron and steel production. He collaborated with other authors in the preparation of articles on gases, metallurgy and welding. He cooperated in successfully developing practical means for locating defects in metals by magnetic methods of testing.

In addition to being a member of the American Welding Society, Mr. McCune was also a member of the American Society for Mechanical Engineers, the Society for Testing Engineers and the Advisory Board of the United States Bureau of Standards.

Current Reviews

Electrode Selector Chart

★ To simplify the selection of the proper electrode for the job at hand, **Air Reduction Sales Co.** has announced the publication of an **Electrode Selector Chart** for use by arc welding operators.

Under separate guides, listed according to the metal to be welded, the chart enumerates such things as the suggested type of electrode, welding procedure and recommended voltage and current values.

Attractively designed, the Electrode Selector Chart is bound so that it can be hung either on the welding machine itself or on an adjacent wall within easy reach of the operator. Copies may be obtained by writing to Air Reduction, 60 East 42nd Street, New York, N. Y.

» «

Spot Welder Bulletin

★ **Condensed Spot Welder data** is included in a new 1-page folder just published by the **Pier Equipment Mfg. Co.**, Benton Harbor, Mich., makers of Ace Spot Welders. Information on the manually-operated types and on the automatic types is segregated with brief description concerning the applications of the various sizes made which run up to 50 KVA.

» «

New Lincoln Catalogue

The **Lincoln Electric Co.**, Cleveland, Ohio, announces the release of a new welding equipment catalogue, **The Lincoln Weldirectory.**

A greater part of the material contained in this new 58 page bulletin is devoted to a description of the various welding electrodes manufactured by the Lincoln Company. Included with the description of the electrode are procedure suggestions for their use in the following operations: flat, vertical or overhead welding of mild steel; single or multiple pass welding and for poor fit-up in mild steel; flat welding of fillet welds in mild steel; flat welding of deep-groove joints in mild steel; flat welding of deep-groove joints in high tensile steels; general welding of high tensile steels; welding of light-gauge steel, 18-8, 25-12, 18-8 SMO and 25-20 stainless steels, 4-6 chrome steels, chromium molybdenum, nickel chrome alloys, high manganese steel, cast iron, aluminum, bronze, brass and copper; for surfacing to produce moderate shock and abrasion-resisting welds; rolling or sliding abrasion-resisting welds; and for making tool steel cutting edges on ordinary steel and rebuilding worn tools and dies.

The Lincoln Weldirectory is available to all users of welding on request from The Lincoln Electric Co., Cleveland, Ohio.

» «

Leaflet On All Purpose AC Welder

A new four page illustrated leaflet describing the **Type WT-4 portable modern ac welder,** designed for all-around general utility service and production welding, has just been announced by the **Westinghouse Electric & Mfg. Co.** These welders have a range of from 20 to 250 amperes and work off of 220 or 440 volt ac current.

The leaflet contains a description of the unusual features of this newly developed welder. Its unique current adjustment scheme, with 27 current steps; its safety features, including low open circuit voltage and built-in circuit breaker pro-

tection. Illustrations of the different parts aid the descriptions.

The complete set of accessories furnished with the welder is listed and shown pictorially. Complete electrical specifications, which include efficiencies, kva input, power factor, etc., for various load current settings are given. A table of weights and dimensions, and complete ordering and price information complete the leaflet.

Copies of catalog section 26-325 may be obtained from department 7N20, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

» «

Miniature Panel Instruments Catalog

A new 12 page illustrated catalog covering the "37" line of miniature panel instruments is announced by the **Westinghouse Electric and Mfg. Co.** These small instruments, approximately 4½ inches in diameter, and available in three mounting styles have a broad field of application; from industrial and radio test apparatus down to the gadget of the amateur experimenter.

The catalog explains features such as dial readability, linear scales, interchangeability of instruments, and numerous others. Operating principles are described and illustrations of the instruments, both individual and installed, are included. Dimension and mounting data are given.

Eight of the twelve pages are devoted to a complete listing including prices, of the entire line, including direct current voltmeters, ammeters, milliammeters, and micro-ammeters; radio-frequency ammeters and milliammeters of the thermocouple type; and rectifier type voltmeters, milliammeters, and micro-ammeters.

Copies of **catalog section 43-370** may be obtained from department 7-N-20, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

» «

Illustrated Lecture

To help decrease industrial eye accidents which annually cost $50,000,000, according to Louis Resnick of the National Society for the Prevention of Blindness, the **American Optical Co.**, Southbridge, Mass., has just published an interesting and dramatic illustrated talk on the cost and causes of eye accidents with suggestions included to eliminate the causes and lower the costs.

The talk is supported by a series of significant charts and has been prepared for delivery before safety engineers, management executives, and people or organizations interested in the safety movement. Copies of the talk can be borrowed from the optical concern which will be glad to supply a speaker to present it, if one is desired. Easily delivered in thirty minutes or less, the talk is free of advertising material.

The theme of the message is — Eyes Are Expensive Targets — and the point is amply proven by factual matter and statistics included in the talk and charts.

This illustrated talk, so far as known, is the first of its kind to be prepared by any manufacturer of safety equipment.

Recent Patents

Electrode

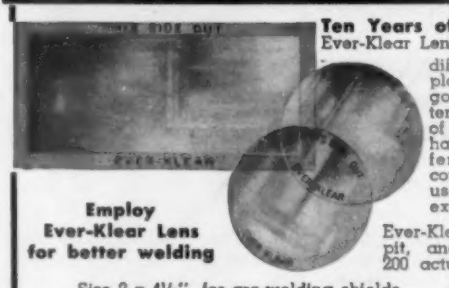
2,214,760. **Jesse J. Brown,** Syracuse, N. Y. Filed Feb. 28, 1938. Issued Sept. 17, 1940. This patent describes a forging electrode for spot or seam welding materials having high electrical and thermal conductivity, such as copper and aluminum. The electrode comprises a central cylindrical forging member or core of strong and relatively high electrical resistance material shaped at its face to contact but a small area of the work piece surface; an outer substantially concentric current-carrying member or shell of low electrical resistance material shaped at its face to contact an adjacent and relatively large area of the work piece surface; elements for pressing the central core unit against the work piece at the necessary forging pressure, and means for independently pressing the outer shell face against the work piece at substantially less than the forging pressure. The conditions of operation are such as to concentrate the forging pressure and distribute the welding current to the surface of the work piece. The electrode is said to maintain its size and shape under prolonged use.

NEMCO WELD FILLER

Makes Cast Iron Electric Welds Water Tight
SAMPLE ON REQUEST
TESTED TO 70 LBS. PER SQUARE INCH
Attractive Proposition to Distributors
NORTHEAST METALS CO. 4124 TORRESDALE AVENUE PHILADELPHIA PENNA.

STRONG, SMOOTH ALUMINUM WELDS ARE NO SURPRISE
You just naturally expect them — when you use
ALMARC Aluminum Welding Rods
ALFLUX Aluminum Welding Fluxes
WOOLDRIDGE ALUMINUM WELDING PRODUCTS
Glastonbury, Conn.

168 Summ...
Everytown, New Yo...
Dear Sir:
When it's SODIUM SILICATE you want, see PQ. Here you find the largest line of grades, conveniently available from nine manufacturing plants or 65 distributing centers. Write for prices, information or let us have a representative call.
Yours truly,
PHILADELPHIA QUARTZ COMPAN
Philadelphia, Pa.
PQ

EVER-KLEAR COVER LENS

Ten Years of Proven Service
Ever-Klear Lens make a world of difference when employed in helmets and goggles. For the past ten years, thousands of welding operators have learned this difference over plain cover glass, and now use Ever - Klear Lens exclusively.
Employ Ever-Klear Lens for better welding
Ever-Klear Lens will never pit, and are guaranteed 200 actual welding hours.
Size 2 x 4¼", for arc-welding shields.....$2.40 per dozen
Size 46½ to 50 M.M., for goggles.....35c per pair
F. R. FAULK, DISTRIBUTOR
405 PENN AVENUE PITTSBURGH, PA.

Resistance Welder

2,214,856. **Werner Jahde,** Berlin, and **Otfried Plass,** Hennigsdorf, Germany. Assigned to **General Electric Co.,** New York. Filed July 13, 1938. Issued Sept. 17, 1940. The machine described in this patent is one in which the work parts are forced together by a motor acting through an elastic intermediate link and in which, after the elastic link has been stressed a predetermined amount, the motor mechanism is reversed until the elastic link is completely relieved of this stress. In the use of this welder a predetermined upsetting pressure is maintained for a definite time interval before the motor mechanism is reversed to relieve the elastic link through which pressure is applied to the electrodes during the welding operation. The elastic link is responsive to electrode pressure and is deformable in accordance with the pressure applied to the electrodes. A motor is used to move the electrodes. When the link has been deformed a certain amount due to pressure of the moving electrodes, the motor which moves the electrodes is automatically reversed, and when the forces producing deformation in the link have been removed, the motor automatically stops.

» «

Welding Hollow Vessels

2,214,899. **Archibald M. Brown,** Akron, Ohio, assigned to **The Firestone Tire & Rubber Co.,** Ohio. Filed May 12, 1938. Issued Sept. 17, 1940. This invention relates to the welding of two dished structures that together constitute a hollow closed vessel. The invention is of primary utility in the manufacture of metal barrels in which the inner shell or lining is composed of corrosion-resisting material such as stainless steel. Barrel linings of this type are made in two sections each of which is a one-piece, drawn metal structure, the sections being united by a circumferential seam. Atomic welding is used to join the section margins. In such welding the two margins to be welded must be supported from the interior, and heretofore the support has been by means of a supporting roller journaled in an arm which extended through the end of one section. The inventor points out that the old method of welding set up stresses by shrinkage of material upon cooling and that fissure-like cracks developed. According to the invention these cracks are avoided by providing a collapsible seam-supporting structure that may be removed from the finished barrel lining through a bung hole in the barrel. The support is flexible and permits flexure of the work at the welding zone to avoid cracks and fissures. In the method the two barrel sections are rotated on an axis normal to the plane of the seam and the seam is welded during the rotation. Concurrently deforming pressure is applied to the seam only immediately in front of and behind the region where fusion is being effected, the pressure being applied to the exterior of the vessel to flex the seam inwardly. At the same time yielding, outwardly directed pressure is maintained against the seam from the interior of the vessel.

» «

Electrode Holder

2,215,289. **Franz R. Hensel** and **Earl I. Larsen,** Indianapolis, Ind., assigned to **P. R. Mallory & Co.,** Indianapolis, Ind. Filed April 25, 1939. Issued Sept. 17, 1940. To avoid the need for separate types of holders for various applications, the inventor has devised an offset holder which can be adapted to welding in almost any position. The new holder provides rotation about both vertical and horizontal axis. The unit also includes a simple tip ejector by means of which the tip may be readily removed for replacement purposes.

» «

Automobile Welding

2,215,693. **Alexander M. Fleming,** Grosse Point, and **Antonio B. Canales,** Detroit, Mich., assigned to **Chrysler Corp.,** Highland Park, Mich. Filed July 16, 1938. Issued Sept. 24, 1940. An apparatus is described which automatically and simultaneously welds the roof and side members of a vehicle body together at a predetermined series of points along successive curvilinear portions of the vehicle body members. The machine then automatically welds intermediate each of the welds first made. The welds are made by moving a welding gun carrying carriage to a predetermined welding

SHAWINIGAN CARBIDE

SHAWINIGAN PRODUCTS CORPORATION
EMPIRE STATE BUILDING
NEW YORK CITY

METAL BOND
SEAL-X-O
SEALS THOSE PIN HOLES

Use SEAL-X-O for sealing pin holes in electric welds, etc. Also used for filler over rough welds.

A—Aluminum. B—Black for Cast Iron.

Made in about six inch sticks, handy to use. Runs about three sticks to the pound. Priced at 50 cents per stick.
Ask your Jobber; if he is unable to supply you, write us direct. Orders shipped day received.

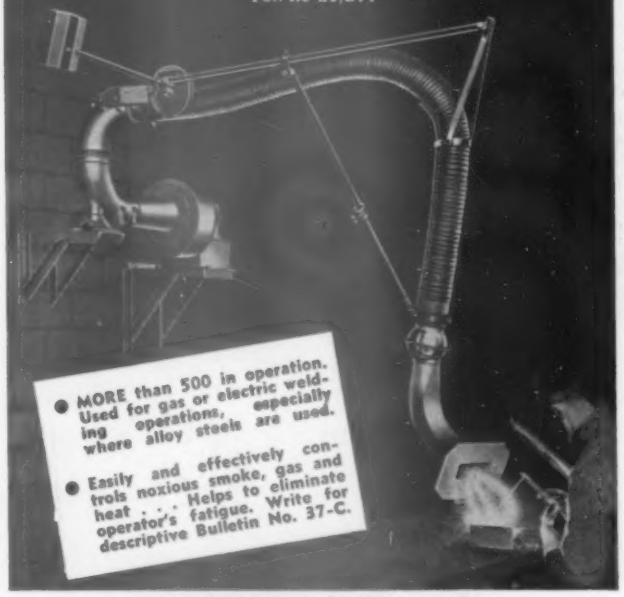
Send post card for our complete Metal Bond Products Catalog

METAL BOND MANUFACTURING CO.
Manufacturers and Distributors
3201 - Kossuth St. Louis, Missouri

Banish Welding Fumes!

Here's a Practical Welding Fume Collector* that Removes Noxious Gases, Heat and Smoke at the Source

*Pat. Re-21,277



- MORE than 500 in operation. Used for gas or electric welding operations, especially where alloy steels are used.
- Easily and effectively controls noxious smoke, gas and heat . . . Helps to eliminate operator's fatigue. Write for descriptive Bulletin No. 37-C.

RUEMELIN MFG. CO.
3880 N. Palmer St. Milwaukee, Wis.

RUEMELIN FUME COLLECTOR

A 2964-½

position, forcefully engaging the work, effecting the weld, and releasing the work and moving the carriage to the next predetermined welding position. Welding is caried out entirely within the vehicle body to avoid defacing marks on the outside of the body. In welding automobile bodies, welds may be formed continuously from the front to the rear of the panel structure even though these panel structures vary in curvature in two planes. In the operation of the apparatus, the operator need not be skilled inasmuch as the machine is purely automatic and fast.

» «

Arc Welding

2,216,564. **Verni J. Chapman,** Schenectady, N. Y., assigned to General Electric Co., of New York. Filed Sept. 16, 1938. Issued Oct. 1, 1940. The object of this patent is to provide a machine for automatically feeding coated electrodes toward and away from the work to strike and thereafter maintain a welding arc. The unit includes a cutter for making a longitudinal groove through the flux coating of the electrode, and an element for scraping the bottom of the groove to provide a clean, bright and smooth electrode surface. The cutting and scraping mechanisms include spring-biased fingers which insure proper pressure on the electrode to carry out the necessary operations. Suitable brushes fit into the cut grooves, and welding current is supplied to the brushes.

» «

Plate Welder

2,216,739. **Clarence W. Hines,** Chicago, Ill., assigned to **Chicago Bridge & Iron Co.,** Chicago, Ill. Filed June 17, 1939. Issued Oct. 8, 1940. In the manufacture of steel tanks, and the like, using sheets of steel, it is desirable to butt-weld the edges of the sheets. In making tanks this way, difficulty has been encountered in aligning and holding the sheets to properly place and locate them preparatory to the welding of the edges. According to the invention of this patent, butt-welded and edge-to-face joints may be made while the sheets are properly aligned and held for welding. The inventor provides hinged plates so that the sheets to be welded need not necessarily be in the same plane but may be angularly adjusted with respect to each other, as desired. This arrangement has particular utility for making right angle welds of side wall sheet to a bottom sheet. Fastening devices for holding the sheets to be welded against the hinged plates hold the sheets firmly for welding.

» «

Welding Heavy Pieces

2,217,468. **Walter Borstel,** Dessau, Germany, assigned to **Junkers,** Dessau, Germany. Filed July 21, 1938. Issued Oct. 8, 1940. The invention is particularly concerned with the production of welds on large structural parts by electrical resistance welding, wherein the workpiece must be so shifted relative to the welding machine that those points at which a welded joint is to be made, are arranged between the electrodes of the stationery welding machine. Such parts include the fuselages and floats of air and seaplanes, boat hulls or the like. Heretofore, the cooperation of several workers was needed to move such large pieces. The new apparatus is such that the workpiece is held in position relative to a stationary part such as a foundation or supporting structure by members movable in all directions relative to the electrodes of the welder. These movable members replace workmen used heretofore. Suitable motors furnish the moving force required. The apparatus includes a stationary supporting structure, horizontal guide rails at right angles to this structure, a traveling frame displaceable along the rails, separate hoisting and shifting units, and a workpiece carrier for rotation about a horizontal axis.

» «

Spot Welding

2,217,546. **Gerhard Hagedorn,** Berlin, Germany, assigned to **Bernhard Berghaus,** Berlin, Germany. Filed Sept. 28, 1938. Issued Oct. 8, 1940. A method of spot welding which comprises, arranging a metal sheet over another metal sheet, applying pressure to the sheets at two points to provide lower resistance between the sheets at these points than the resistance between the sheets laterally of these points, applying an alternating magnetic field to the sheets between the points so as to produce eddy curents which flow along one sheet to one of the pressed points and then pass to the other sheet and flow along the second sheet to the other pressed point before passing again to the first sheet. In passing from one sheet to the other, the current is concentrated at the pressed points to provide spot welds. A high frequency current of 300 to 20,000 cycles per second is suitable. This method dispenses with welding electrodes. The method is also suitable for seam welding and the seam may be produced by causing lapped or not lapped spots to follow one another.

» «

Tubular Welding

2,217,985. **Harry J. Klug,** Aspinwall, Pa., assigned to **The National Supply Co.,** Pittsburgh, Pa. Filed Sept. 16, 1939. Issued Oct. 15, 1940. This patent describes a method of progressively shaping heated flat metal skelp to cylindrical shape for forming welded tubing, comprising initially applying opposed pressures to the exterior face of the skelp solely at points spaced from its edges while passing the skelp through a pair of cooperating shaping rolls. An apparatus is also shown.

» «

Butt-Welding

2,217,964. **Edward F. Nelson,** Vallejo, Calif. Filed Oct. 7, 1938. Issued Oct. 15, 1940. A machine is described for welding studs at any angle to a plate. A welding gun holds the stud for movement relative to the plate onto which the stud is welded. By means of suitable spring elements the stud may be moved away from the plate to strike an arc, after which the stud is moved against the plate for welding.

» «

Welding Mask

2,174,667. KAISER W. MENTETSKI, Chicago, Ill. Filed April 2, 1937. Issued Oct. 3, 1939. A helmet is described which has a sight opening covered by a ray filter to shield the eyes against harmful rays generated in welding. The filter may be made to uncover the sight opening for clear vision by a mechanism actuated by a movement of the chin of the welder.

Fluxes cost SO LITTLE yet are SO IMPORTANT

Use only those GOOD Guaranteed

"ANTI-BORAX" FLUXES

"A FLUX FOR EVERY METAL"

Cast-Iron Flux No. 1; Brazing Flux No. 2; "Braz-Cast" Flux No. 4 (for bronze welding cast-iron); Aluminum Fluxes Nos. 5 and 8; Stainless Steel Flux No. 9; Silver Solder Flux No. 10; Tinning Flux No. 11.

Send for Free Samples

MANUFACTURED ONLY BY

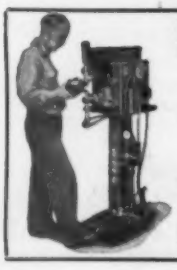
ANTI-BORAX COMPOUND CO., Fort Wayne, Ind.

BUY NO acetylene oxygen CYLINDERS

Until You Receive Our Quotations and Delivery Schedule

Independent Cylinders have many advantages in design and construction.
Let us send you details and quote you on your requirements.
Write today.

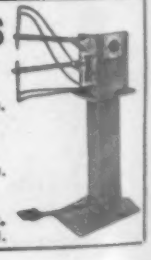
INDEPENDENT ENGINEERING COMPANY
Dept. 104, O'Fallon, Ill.



Weld With EISLER WELDERS

SPOT WELDERS
BUTT • WIRE • SEAM
A.C. Arc Welders from 100 to 400 Amp.

Welders as low as $25.00
ASK FOR 38-W CATALOGUE
1250 WELDING ILLUSTRATIONS
Submit Samples for Test. No Obligation.
CHAS. EISLER, Pres.



Eisler Engineering Co., Inc.
749 S. 13th St., Nr. Avon Av., Newark, N.J.